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PUBLIC HEALTH

THE LOMB PRIZE ESSAYS

Award made at the Thirteenth Annual Meeting

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WITH AN APPENDIX

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INTRODUCTION.

The four valuable papers which constitute this volume are the result of prizes offered by Mr. Henry Lomb, of Rochester, N. Y., through the American Public Health Association, for the best essays on the four subjects presented. This volume has been prepared for the express purpose of placing the essays in a form suitable for public and private libraries, with a comprehensive index. The essays have also been printed in pamphlet form, as will be seen by reference to the advertisement on the last pages of this work.

That these essays may be placed in the hands of every family in the country is the earnest desire of the Association, as well as the heartfelt wish of the public-spirited and philanthropic citizen whose unpretentious generosity and unselfish devotion to the interests of humanity have given us these essays; but the financial inability of the Association renders it impossible to distribute them gratuitously; therefore, a price covering the cost has been placed upon these publications. It is to be hoped, however, that government departments, state and local boards of health, sanitary and benevolent associations, etc., will either publish these essays, or purchase editions at cost of the Association, for distribution among the people.

Although a copyright has been placed upon these essays for legitimate protection, permission to publish under certain conditions can be obtained by addressing the Secretary.

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HEALTHY HOMES AND FOODS FOR THE WORKING CLASSES.

By VICTOR C. VAUGHAN, M.D., Ph.D.,
Professor in University of Michigan.

HE WHO SECURES A HEALTHY HOME AND HEALTHY FOOD FOR HIMSELF AND FAMILY DOES NOT LIVE IN VAIN.

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I.

BUILDING A HOME.

LOCATION.

The location of the home of the working-man is often determined by considerations over which he has no control. Cost of land and distance from place of labor must influence the selection. If possible, however, the house should not be located in a low, damp place, nor on made earth. In cities, many low tracts, and even the beds of small streams, marshes, and lakes, are filled in with general refuse, such as street sweepings, back-yard rubbish, ashes, and garbage. Such soil, unless thoroughly under-drained, must be unfit for the location of habitations. It is damp, and will for years be filled with the products of decomposition arising from the putrefaction of the garbage deposited there. Houses built in such locations must be damp, musty, and unhealthful. The inmates of a house built in such a place are likely to suffer from malaria, bilious fever, and rheumatism, even if they do not fall victims to the more dreaded diseases, typhoid fever and consumption. The house should also be far from marshes and other low lands, whose surface is covered with water in the spring and early summer, and then exposed later. Such situations are likely to be malarious. Neither should the home be located near manufacturing establishments which usually have much garbage about them, such as breweries, tanneries, glucose factories, rendering houses, and oil refineries.

The site should be one which is naturally well drained; and whether this be the case or not often cannot be decided in cities without consulting maps which show the original lay of the land before any grading had been resorted to, though the position and course of neighboring streams and the location of springs may suggest valuable information. The slope of the land should be from the house. Extra precaution must be taken when it becomes necessary to build at the foot of a hill which is covered with houses from which the surface water and under-ground drainage flows toward the home. The location of neighbors' out-houses, with reference to the proposed home, should also be taken into consideration. While an intelligent man will not neglect the sanitary condition of his own premises, his neighbor's cesspool or privy vault may drain into his well and poison his drinking-water. Have the house upon a place high enough, and as dry as possible. Avoid, whenever practicable, narrow streets, which are devoid of sufficient sunlight and pure air. The width of the street should be twice the height of the houses along

it, and no street, even in the business centres of cities, should be narrower than the height of the houses. In many of the older cities, however, the streets are narrower than this.

The best soils upon which to build are gravel, marl, and limestone; for in these the drainage is likely to be better than in others.

A due amount of shade around the home renders it more healthy, but the shade should not be dense enough or close enough to the house to obstruct the air and light.

THE CELLAR.

Every dwelling-house, even that which has but one room in it, should either have a cellar, or should be raised sufficiently high from the ground to allow a free supply of air under it. The walls of the cellar should be perfectly water and air tight. It is better, in making the excavation, to remove the earth a foot, on all sides, further than the line on which the outside of the wall will stand; then, after the walls have been built, pack the space with clay or gravel. In this way the walls of the cellar are more likely to be kept dry. If built of brick the walls should be hollow, consisting of a thin outer wall two or three inches from the main wall. The two are firmly held together by occasionally placing a brick across from one to the other as the walls are being built. Unless this is done, moisture will pass through a brick wall, it matters not how thick it may be.

The cellar floor should be of concrete, about six inches thick, and covered with Portland cement or asphalt. If the soil be very damp, tiling should be placed under the cellar floor, and carried out beneath the wall to a larger tile which passes around the house and leads off into some suitable receptacle.

It is absolutely essential to a healthy house, that its cellar should be free from dampness and ground air. In order to secure these requisites, the walls and floor of the cellar must be well built, even if it becomes necessary, on account of increased cost, to deprive the superstructure of some of its ornamentation.

The cellar should be well supplied with light by having windows above ground, or by sunken areas in front of the windows. The window-sashes should be hung on hinges, so that they may be easily opened when the cellar needs an airing.

If the cellar is to be used for several purposes, as the location of the heating apparatus and the storage of fuel and vegetables, it should be divided into compartments, the temperature of which may be kept at different degrees.

Basement bed-rooms are almost universally unhealthy, and should be used only in cases of absolute necessity. It is also best not to have the kitchen in the basement, especially if the room directly above be occupied. If stationary wash-tubs be placed in the basement, they should have a metallic or porcelain lining, and the pipes which conduct the refuse water from them should be thoroughly trapped.

THE WALLS.

If built of brick the walls of the house should be hollow, as described in referring to the walls of the cellar. Furthermore, the plastering should never be placed directly on the brick. The inside of the wall should be "furred," scantling nailed to the furring, and the lathing done as in a frame house. It has been found that a single brick will absorb as much as one pound of water ; and if a brick wall be built solid and the plastering placed directly on the brick, the house will be constantly damp. Many of the older brick houses are constructed in this manner, and consequently their interiors always have a damp, musty odor, it matters not how untiring the housekeeper may be in her efforts to have everything sweet and clean.

Even in case of a stone wall, the plastering should not be placed directly on the wall ; though stone does not absorb water to any such extent as brick does.

New brick and stone walls are necessarily damp, and for this reason houses built of either should not be occupied until some weeks after the building of the walls. In order for them to dry thoroughly they must be pervious to air ; and walls built as recommended above will allow the air to pass through them freely. Plastering does not prevent the air from passing through the walls, but papering does. However, as papering is the most economical way in which walls can be decorated, it will long continue in use. Wall papers containing arsenical colors have been, and are still to some extent, used. Rooms decorated with such papers are not suitable for living apartments. It is generally supposed that only the green colors contain arsenic, but, in truth, it may be present in paper of any color. The only way, then, by which they may be avoided is by having the selected samples tested. Any intelligent druggist or chemist will make the analysis for a small fee, which should be at the expense of the paper-dealer.

A nice way of finishing inside walls is to paint and then varnish them. The varnish prevents the rubbing off of the paint, and places the walls in in such a condition that they may be washed whenever desirable.

THE FLOORS.

Floors should be made tight, so that they may be thoroughly scrubbed with soap and water occasionally. The best floor, from a sanitary view, is one of hard wood, planed smooth, and oiled. It is far better to have a clean, bare floor, than one covered with a filthy carpet. However, where carpets are kept clean, and are occasionally taken up and the floor scrubbed, there is no objection to their use ; and it must be admitted that a clean carpet adds much to the comfort of a room. A cheap straw matting is now made, which can be washed when necessary, and it will not retain dust and filth to the extent that woollen carpets do. Such a covering is especially suitable for dining-rooms.

ARRANGEMENT OF ROOMS.

The living-rooms should be on the sunny, airy side of the house. Human beings as well as plants demand sunlight. Too frequently the good housewife shuts out the sunlight for fear that it will fade the carpet. As some one has said, "It is far better to have faded carpets than to have faded cheeks." A little saving in the color of the carpet is poor economy when it is secured at the cost of health. Especially should the room occupied by the women and children, who are indoors much of the time, be well supplied with light. If there is to be a long, dark hall or passage-way in the house, let it be on the side upon which the least sunlight falls, and place the living-rooms on the other side.

It is, unfortunately, the fashion to make bed-rooms small in order to have a large sitting-room. Too often the bed-room is a mere recess scantily supplied with fresh air. It is better to have a smaller sitting-room and a larger bed-room. Even farmers often suffer from diseases which are due to an insufficient supply of pure air. This arises from the fact that for six or seven hours out of every twenty-four they are shut up in small, tight, musty bed-rooms, and are compelled to rebreathe the air which they have already once breathed.

As has been said in discussing the cellar, basement bed-rooms are always poorly supplied with fresh air, and are generally damp and musty. They should be used only in cases of absolute necessity. Attic bed-rooms are cold in winter and hot in summer, and their use also can be excused only on the question of dire necessity.

If the owner of the house can afford it, at least one bed-room should contain a grate or fire-place,—for, with every attention to the laws of health, there will come times when some member of the family will be sick; and the sick-room should be full of cheer. The open fire is cheerful, and serves as an excellent ventilator. Pleasant surroundings often aid the doctor's pills and potions in restoring the patient to health.

Of course the number and exact arrangement of the rooms will depend upon the purse of the owner; but a cottage may be built so as to be as healthy as a palace,—and indeed the advantage is often in favor of the former, as the more complicated finishings and elaborate furnishings of the latter may serve as harbors for dust and filth.

Space may often be saved by doing away with the conventional long, dark hall, and by having the stairs go up from a sitting-room or from a smaller vestibule. The long halls are often cold, dark, and dreary. In winter they are filled with cold draughts, and in summer they are receptacles of refuse of various kinds, and at all times they are cheerless. They may be necessary in certain houses, but in small homes they are neither ornamental nor pleasant.

It is the ambition of most American housewives to have a parlor, in which the most valuable household ornaments are placed, and which opens only when some honored guest comes. The small boys of the family look upon it as forbidden territory, and too frequently both fresh

air and sunlight are regarded as intruders, and are shut out. The exclusion of the small boy may be all right, but the air and sunlight should not be treated with so much discourtesy. Indeed, they should be considered the most honored guests, and should be welcomed even to a place in the parlor.

Probably the most important room in the house is the kitchen. Before you praise the housekeeping of any woman, visit her kitchen. The parlor may be a beauty, the bed linen may be spotless, the table may be covered with decorated china, but if the kitchen be filthy, all is in vain. But in order that the kitchen may be kept in good condition, its construction must be proper. The floor is best of hard wood or yellow pine; or, if these are too expensive, of selected white pine. They should be kept bare.

At least two windows, one on each side, are desirable. A pantry or shelves for setting aside clean cooking utensils and dishes should be at hand. If the cellar be used for the storage of vegetables, an inside stairway from the kitchen or pantry should lead down into it. The flour-box in the pantry should be so hung that it will close itself. It adds much to the comfort of the cook, and to the cleanliness of the walls and ceiling of the room, if the stove or range be covered by a hood which conducts the vapors arising from the cooking food into a flue in the chimney.

If the owner can possibly afford it, the house should contain a bath-room. In the absence of public water-supply, a force-pump below, a cold-water tank in the attic, and a hot-water tank attached to the kitchen range will furnish the bath-tub. The room should be heated either directly or from another room, otherwise it would not be used much in cold weather. The cost of the bath-room and its supply need not be great, while the pleasure and benefit derived from its use will be appreciated.

THE WINDOWS.

The importance of an abundant supply of sunlight has already been insisted upon. If possible, every room should have direct light, and not be dependent upon that which is diffused through an adjoining room. The location of the windows should be such as to give the greatest amount of direct sunlight. The windows should extend well towards the ceiling, and should be hung so as to lower from the top as well as raise from the bottom.

The window shutters or blinds must be hung in such a manner that they are easily opened. In no part of the house should they be kept closed during the day.

HEATING AND VENTILATION.

It would be wholly out of place to attempt here any elaborate discussion of the many methods of heating and ventilating buildings now in use. Only a few practical statements will be made with reference to securing adequate warmth and sufficient fresh air in dwellings.

The most common methods of heating small residences are by the stove, open fire, and hot-air furnaces. The stove is the most economical. The open fire is the most enjoyable, and where it is sufficient, the most healthy; but in the Northern states the open fire alone seldom furnishes enough heat during the coldest months. The hot-air furnace may be so constructed as to be a good method, but care must be used in selecting the furnace and arranging for ventilation.

In small houses the heat is generally supplied by stoves. In rooms which are occupied only during a few hours of the day the wood stove is sufficient, and, indeed, has certain advantages. The room can be quickly heated, and when left, the fire soon dies out, thus saving fuel. But where the room is constantly occupied, coal is a more suitable fuel than wood. The temperature is more even, and the fire burns more slowly. The relative cost of these fuels varies in different sections.

The coal stove should have no loose joints through which gases can escape. The mica doors should be kept in repair, and the flue must not be allowed to clog. The principal gases given off from burning coal are carbonic acid gas, carbonic oxide, and sulphurous oxides. The carbonic oxide is poisonous when inhaled in any quantity. It produces a sensation in the head similar to that which would be caused by a tight band; and in larger amounts it renders persons insensible, and may produce death. It should be remembered that the carbonic oxide is without odor. Whole families have been fatally poisoned with it. Especial care must be taken with coal stoves which are used in bed-rooms or in rooms which communicate with bed-rooms, as the carbonic oxide may prove fatal to persons while sleeping, without waking them. But there is no danger if the stove and flue be in proper condition. Makers of wrought iron stoves and furnaces will insist that these gases pass readily through cast iron, and for this reason their stoves are superior, and free from danger; but a properly constructed and properly managed cast iron stove or furnace is free from danger, and in many respects is superior to those made of wrought iron. Especial attention should be paid to the position of dampers in coal stoves at night.

One of the greatest objections to the use of stoves is, that in houses in which they are used there is generally no attempt at ventilation. However, a house heated with stoves may be as well ventilated as any other. In houses as ordinarily built, much fresh air will come in through the crevices around the doors, windows, and baseboards. But if many occupy the room, the amount of fresh air which finds admittance through these channels may be insufficient: especially is this likely to be the case if the room is partly surrounded by other parts of the building, and consequently has but a small surface directly exposed to the out-door air. Besides, the direct draughts from doors and windows may be so great as seriously to affect the health of the inmates, giving them colds. When any of these troubles exist, one of several simple devices may be resorted to in order to secure the admission of plenty of fresh air without dangerous draughts. The most common of these devices consists in fitting a

piece of board from four to eight inches wide in the window frame under the lower sash. By this means a space is left between the bottom of the upper and the top of the lower sash, through which the air enters, and the current is thrown upward, striking the ceiling, from which it is diffused all over the room. Dr. Keen recommends tacking a piece of cloth across the lower eight or ten inches of the window frame, then raising the lower sash to a greater or less extent, according to the weather. In this way two air vents in the window are established, one under the lower sash, the current of which is turned upward by the cloth, and the other between the upper and lower sash, as when the board is used. Through the upper vent it is supposed that some of the foul air will escape, though the current through this opening is not invariably outward.

What is known as Maine's elbow-tube ventilator consists of a board placed under a raised sash, as already described. This board carries two tubes, about six inches in diameter, which turn upward, and the ends of which are supplied with valves by which the amount of in-flowing air can be regulated.

Another method provides for smaller tubes brought through the wall and turned upwards into the room. Some favor still another plan, which consists in bringing a tube about six inches in diameter through the wall, and, possibly, under the floor to the stove, where the tube terminates in a sheet-iron jacket placed around the stove, leaving a space of one or two inches, and having escapes only at the top of the jacket. The heat of the stove will produce a strong current through the pipe, and the incoming air will be warmed in passing through the jacket.

By any of the above mentioned devices, abundant facility may be furnished for the admission of fresh air; but as two bodies cannot occupy the same space at the same time, there must be provided some escape for the foul air. This should always be attended to in the construction of the house. For every room which is to be heated by a stove, there should be two flues, one for the smoke and other gaseous productions of combustion, the other for the removal of foul air from the room. The ventilating flue must come to the floor, just above which should be a register. When there is a fire in the stove, the upper part of the ventilating flue will be warmed by the smoke flue, and consequently there will be an upward current in it. In this way the withdrawal of the foul air is rendered certain. It should also be seen, in the construction of the chimney, that the inside of this ventilating flue is not left so rough as to impede the flow of air through it, and that it is not clogged with mortar or pieces of brick. A good draught through the ventilating flue is almost of as much importance as the draught of the smoke flue.

The partition between the smoke and ventilating flues should be of brick placed on edge, thus making it as thin as possible, so that the upper part of the ventilating flue will be thoroughly heated from the smoke flue. By another method the smoke flue may be made of iron pipe placed in a large flue, and the space all around the pipe will serve as the ventilating flue. I have stated that the register in the ventilating

flue should be near the floor. If near the ceiling, as some would have it, there would be too great a loss of heat, as the fresh air as soon as heated would find its exit. For summer ventilation, the foul air outlet may be at or near the ceiling; but such ventilation in winter costs too much, and, besides, when it is used, great difficulty will often be experienced in heating the room.

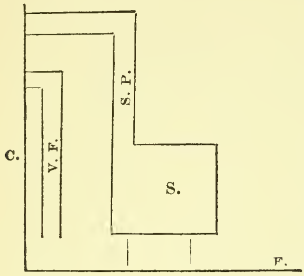

Fig. 1.—F., floor; S., stove; S. P., stove pipe; V. F., ventilating flue; C., chimney.

With the plan recommended above, there is no reason why any room heated with a stove may not be so well ventilated that no disagreeable odor will be perceptible to the most sensitive person upon coming in from the outdoor air; provided, always, that the room is clean. Unfortunately, however, the great majority of houses which are heated by stoves are built without the slightest provision for ventilation. In such houses, fresh air may be introduced according to the methods already given; but the escape of the foul air is more difficult to be provided for. It may be done, however, as follows: Place a tin or sheet iron pipe, of from six to ten inches in diameter, according to the size of the room, along the wall behind the stove. The lower end of this pipe extends to within a few inches of the floor, and remains open, while the upper end passes, by means of an elbow, into the smoke flue below the point at which the stove pipe enters, as shown in the accompanying Fig 1. The upper end of the ventilating flue may, when the chimney begins near the ceiling, terminate in a jacket around the stove pipe, the jacket passing into the chimney as here shown in Fig. 2. In all cases the ventilating flue is to have air-tight joints.

With the open fire or grate, the withdrawal of the foul air is all provided for, as it will escape up the chimney. The open fire is not so economical as the stove; but, when sufficient to warm the room, the former is, at least as both are ordinarily arranged, more healthful. With the open fire or grate, much of the heat escapes up the chimney; however, with the grate this loss of heat can be, to a considerable extent, lessened by setting the fire-basket well forward.

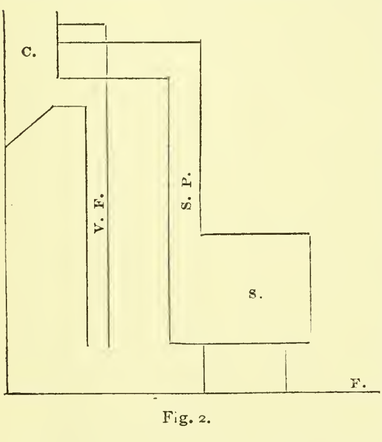

Fig. 2.

When the hot-air furnace is used, certain precautions are desirable, both for economy and health. In the first place, the furnace selected is nearly always too small for the extent of heating required of it. When this is the case, the fire must be pushed as much as possible in order to keep the rooms warm in winter; consequently the air entering the room is over-

heated, and produces headache and dulness. At the same time the furnace is soon burnt out, and any money saved in the first place by purchasing the smaller size will have to be expended with an additional amount in securing a new furnace.

The furnace should be thoroughly encased with thick brick walls, to prevent great loss of heat by direct radiation in the cellar. The owner of the house will be rewarded for his time and trouble if he sees to it that this work is well done.

The furnace must receive the air which is to be heated directly from the out-door air, and not from the cellar. The cold-air duct should be perfectly air-tight, so as wholly to prevent the cellar air from entering the heating chamber. Wooden air-boxes are not to be recommended unless they be carefully lined with some metal. The external opening of the cold air box should not be near any cesspool, drain, or other possible source of deleterious gases. It should also be protected by a piece of wire net. In the cold-air duct, preferably near its external opening, should be a sliding valve, by which the amount of air passing to the furnace can be regulated; but care must be taken that this valve is never entirely closed. Probably it would be better to have it made so that when pushed in as far as possible it will obstruct only half the area of the duct.

The air chamber in the furnace should be kept supplied with water. The hot-air flue should be so arranged that the horizontal ones are not more than fourteen or sixteen feet in length, for if the horizontal flues be much longer than this, the draught through them will be so slight that the rooms will not be warmed, while the rooms supplied with vertical pipes will be over-heated.

The warm-air register in the room should not be placed directly in the floor, but in the base-board. If placed in the floor, it soon receives a large amount of dust and other refuse.

With a hot-air furnace properly selected and arranged, the amount of warm, fresh air entering the room is sufficient. But before the fresh, warm air can enter, the air already present must find an exit. The following principles may guide us in economically ventilating a room heated with a hot-air furnace:

(1) Bring the fresh air in near the floor.

(2) Take the foul air out near the floor.

(3) Create a draught in the foul-air shaft by means of heat.

Unless the air already in the room has some means of exit, it will be found utterly impossible to heat the room with the warm-air furnace. Then it will be seen that both the heating and ventilation depend largely upon the withdrawal of the foul air. If the foul air register be near the ceiling, much of the warm air from the furnace will escape directly into the foul-air shaft. If there be an open fire in the room, the foul air will find a ready exit through the chimney. If there be only a ventilating flue, it should be in the same chimney with some other flue which is heated, at least in its upper half. Thus a number of ventilating flues

from as many rooms may be placed in the same chimney with, and arranged about, the smoke flue of the furnace. Often we find that one ventilating flue is expected to do service for a room on the first floor, and also for another directly over it on the second. The result frequently is, that the foul air of the lower room passes into the room above. There should be a separate ventilating flue for each room.

WATER-SUPPLY.

It is of the greatest importance to the family that its supply of drinking-water be of unquestionable purity. That such dreaded diseases as cholera, typhoid fever, scarlet fever, diphtheria, and dysentery may be spread by impure drinking-water, there can now be no question.

The sources of drinking-water may be divided into the following classes:

(1) Cistern water.
(2) Surface water.
(3) Subterranean water.

Cistern water is that which is collected upon the roof of a house, and stored in a reservoir known as a cistern, or in a tank, which is usually placed in the attic of the house. Cisterns, or underground reservoirs, are more generally used than tanks.

The condition of this kind of water will be influenced by the air through which it falls, by the nature of the roof, and by the kind of cistern, and the care exercised in keeping the roof and cistern clean.

In large cities, especially where there is much manufacturing done, there is always a considerable amount of dust and other impurities in the air, much of which is brought down with the rains. The conductors leading from the roof to the cistern should be supplied with means for turning off the first part of the rain-fall. In this way the impurities taken from the air and those collected on the roof are disposed of. Especially is this desirable if the roof be of wood and old, if there be a collection of leaves and other *débris* from projecting branches of trees, and if there be any chance of birds depositing their excrement upon the roof. Probably the cleanest roofing material is slate; but its cost has prevented its general use in the construction of residences.

The cistern should be built of brick, and plastered water-tight upon the *outside* as well as upon the inside. Strict attention should be paid to this, and the walls should be so built as to prevent the possibility of water from the adjacent soil passing into the cistern.

The top of the cistern should be well covered, so as to prevent small animals as well as vegetable refuse from falling in. The best covering would be a box built up several feet above the ground, and covered with fine wire netting. In this way the fresh air will pass down, and the space above the surface of the water will be ventilated. When this cannot be used, a tight covering of stone, or of wood, if all boards are removed and replaced by new ones at the first sign of decay, may be used.

A wooden pump should not be placed in the cistern, as it soon decays, becomes covered with moss, and collects upon it much filth. An iron pipe with the pump in the kitchen is probably the best arrangement. However, the cistern should never be built under the house. When so built the air above the water is invariably bad, and the periodical cleaning out of the cistern, which should be done once a year at least, is not so likely to be attended to.

It is customary in some places to place near the top of the cistern an over-flow pipe which leads into a cesspool or privy-vault. This practice has, without doubt, cost many lives. There should not under any circumstances be any connection between the cistern and any receptacle of filth. This over-flow pipe is often untrapped, or the trap becomes defective, and the gases arising from the decomposing matter of the cesspool and privy-vault pass into the cistern. Indeed, cases are known where not only the gas, but fluid refuse, has thus been poured into the cistern.

However much care may be taken with the cistern,—and the above suggestions should be deemed of imperative importance,—the cistern water should be filtered before used. Many cheap and effective household filters are made, and it is not necessary to go into detail concerning their construction; but a few practical hints may be given as to their care. A filter which is kept constantly under water soon becomes utterly worthless. The charcoal box should be frequently exposed to air, and, if possible, to direct sunlight. A filter removes suspended matter, and, on account of the air condensed in the pores of the charcoal, destroys to a certain extent the organic matter held in solution in the water. If any epidemic disease prevail at the time, it is always safest to boil any and all water used for drinking purposes. Cistern water may be boiled and then filtered. If one has no regular filter, it will be better at all times to boil the water, after which it may be allowed to run through a piece of filter paper, which can be obtained for a trifle at any drug store, placed in a tin or glass funnel. When filter paper is used, a new piece should be placed in the funnel each day.

The purity of surface water will depend on the condition of the soil upon which it falls and over which it flows, as well as upon the air through which it falls. Water which falls upon and flows over a filthy soil should not be used for drinking. Since the amount of refuse on the surface of the earth is usually greater in thickly settled countries, the water collected on such sheds is unfit for use. That there is a certain degree of purification in running streams there can be no doubt; but notwithstanding this, specific poisons have been carried long distances in rivers, and have still manifested their poisonous effects.

When any serious epidemic prevails, and surface water constitutes the drinking supply, it should always be boiled. In India, the spread of cholera is often along the water-courses into which excrement from the sick and the bodies of the dead are often cast. Typhoid fever and dysentery are also often spread by the use of surface water.

The water collected in shallow wells is really surface water, and that often of the worst kind. The use of drinking-water from shallow wells is, as a rule, to be condemned. Many people think if water percolates through a few feet of soil, every harmful substance is removed. No greater mistake could possibly be made. Indeed, by percolation through the soil, the impurity of the water is often increased. Various kinds of filth which have accumulated upon and within the soil are dissolved in the water and carried into the well. Often we find in a small back yard a cesspool, privy-vault, and well, all in close proximity. If the well be a shallow one, such an arrangement is probably the worst, in a sanitary sense, that could possibly be devised.

Subterranean waters used for drinking purposes are those obtained from springs and deep wells. Whether such waters are pure or not depends largely upon the geological formations in which they exist. The source of the water must be below rock or thick clay beds in order for the water to escape surface contaminations. Springs from gravel hills may be as impure as shallow wells. A very small amount of iron in water does not render it unfit for drinking; but water which contains more than one tenth of one per cent. of iron is unfit for constant use.

Deep wells should have their walls so protected as not to permit of surface water finding its way through them. If this is not the case, their waters may become quite as foul as those of shallow wells.

Subterranean waters are often hard. By this is meant that they fail to make a lather with soap, or a large amount of soap must be used with them in order to produce a lather. The hardness of water is due to the presence of certain inorganic salts, as those of lime and magnesia, which form insoluble compounds with soap. Hard waters are divided into two classes:

(1) Those whose hardness is removed by boiling. This is known as temporary hardness.

(2) Those whose hardness is not removed by boiling. This is known as permanent hardness.

Many waters possess both a temporary and permanent hardness. Such waters are improved by boiling, but are not rendered wholly soft.

Hard waters are not suitable for laundry purposes, especially when the hardness is largely permanent. They also often form incrustations in boilers. But unless the hardness be very great, it does not unfit the water for drinking purposes. There has been much discussion as to the possibility of hard waters producing goitre. It is well known that this disease is very prevalent in certain limestone districts; but that the use of hard water for drinking is the cause of the disease has not been positively demonstrated. It would be best, however, for families in which a tendency to goitre prevails to use soft water.

Hard water has also been supposed to favor the formation of gravel. The writer has met with a few persons who are troubled with gravel only when using hard water.

Some hard waters have an irritating effect upon the bowels of those not accustomed to their use, producing in such persons diarrhœas.

In case of the use of a public water-supply, it is the duty of the health authorities of the city to see that the water is wholesome, and it is the duty of the consumer to see that the water is not contaminated on his premises. Lead pipes and lead lined storage tanks should not be used for conveying or storing cistern water. The pipes should be of iron, or better still, of block tin, or should be lined with tin.

THE DISPOSAL OF WASTE.

One of the most important questions connected with modern sanitation is as to the best methods of disposing of waste matter. When allowed to accumulate in the vicinity of homes, it may poison both the water and the air. Many of the older cities of southern Europe have become thoroughly saturated with filth, and for this reason cholera has found a fertile field for its growth in Spain, Italy, and southern France. Filth and disease always go hand in hand, the former leading the latter. Cleanliness invariably lessens the death-rate. Typhoid fever, cholera, and other diseases, whose growth and spread are plainly due to the accumulation and putrefaction of waste matter, should be stamped out of existence. With perfect cleanliness they would not be known.

It is the writer's object to give here some practical suggestions for the disposal of waste matter. Probably the disposal of human excrement deserves more care than any other waste. In cities where there is an abundant public supply of water, and where sewers are in use, the water-closet is the most convenient method, and it may be made perfectly safe. Where water-closets are used, the so-called "separate system" of sewerage is desirable. This system provides two sets of sewer conductors. One of these is the ordinary brick sewer, and this system is used only for carrying off the storm-water. The other is made of small sewer pipes which convey the sewage proper, and which are connected with flushing tanks, by means of which they are periodically flooded with water and washed clean. The advantage of this method is easily understood. When the single system is used, the sewers are necessarily large, in order to carry off the great amount of rain-water. The bottom and sides of these sewers must be more or less rough, and they are flushed only at the time of heavy rain-falls; consequently much of the time the flow of sewage through them is slow, and the solid matter is deposited on the rough surfaces, where it decomposes with the formation of noxious gases, which escape through ventilators into the street, or pass through defective traps into the houses.

With the separate system the small sewer pipes with smooth inner surfaces are flushed three or four times a day, and their contents are swept out. It requires twenty-four hours at least for human excreta to decompose to such an extent as to evolve poisonous gases; therefore, if the pipes be flushed clean one or more times during the day, there can be but little danger from "sewer gas."

However, whichever system of sewerage is in use, the individual should take certain precautions in arranging his water-closets. In the first place, water-closets should not be placed in living-rooms or in bedrooms. They should be located if possible in some detached part of the house. The kind of closet selected should be determined upon by some competent person. Changes and improvements in the patterns are being constantly made, so that should any preference be given at this time it might not hold good three months hence. The flushing tank for the water-closet should not in any way be connected with the drinking water-supply. The closet should be well trapped, and the trap should be so placed that it can be examined at any time without tearing up the floor or breaking into the wall. The habit which plumbers have of hiding all their work should be condemned. The soil pipe should not be connected at any point inside of the house, at least with the other waste pipes, such as those from the bath-tub and stationary wash-bowls. The soil pipe should be ventilated by a pipe which should be as nearly perpendicular as possible, and which should extend above the roof of the house, and should not be placed near a window. This ventilation of the soil pipe is of the utmost importance, and should never be neglected.

When there is no system of sewerage, the dry-earth closet is the best method of disposing of human excrement. Indeed, upon sanitary grounds the dry-earth system is in many respects more desirable than the use of water-closets; but the former requires possibly more care than the latter. Economically, also, the dry-earth system will prove the better when it comes into more general use, and the excrement is used as a fertilizer. A dry-earth closet properly kept is free from all noxious gases, and there is no possibility of the drinking water-supply becoming contaminated from it.

There are many patterns of dry-earth closets in use, but the simplest may be made as efficient as the most complicated and costly. A cheap form is made by placing under the seat boxes or drawers lined with galvanized iron. There is placed conveniently a quantity of dry earth, and for each evacuation a small shovel of the earth, from one to two pounds, is thrown in. When the drawers are full they are removed, emptied, and replaced. The best earth to use is pulverized clay mixed with about one third its weight of loam. Ordinary garden soil may be used, if dried perfectly. Sifted coal ashes are almost or quite as good as any earth. Moreover, they are generally on hand, and to be disposed of in some way. The writer has used for his family a dry-earth closet for three years, and prefers the sifted coal ashes to any kind of earth. Gravel is not at all suitable.

With an ordinary family with not more than half a dozen members it is not necessary to empty the boxes more than once in three or four weeks. Their contents, which if enough soil or ashes has been added, is wholly inodorous, and may be emptied upon the garden. Here it is spaded in during the spring, and as a fertilizer amply repays for the time and trouble that has been taken with it. Several large cities in Europe

have adopted the dry-earth system, and the waste is removed by those who desire to use it as a fertilizer.

The patent earth-closets are so arranged that the requisite amount of earth falls into the box in a manner similar to that by which the water-closet is flushed with water.

In case epidemics of any kind are prevailing in the neighborhood, it would be well to throw a handful of chloride of lime into the closet each day. And even when no epidemic prevails, but the weather is very hot, the same quantity of sulphate of iron (copperas) may be used daily. The cost of this substance is so small that it may be used freely when needed. Where many are using the closet, a vault may be dug beneath the seat, and made water-tight with brick and cement. Into this should be thrown each day a sufficient quantity of this dry earth, and the vault should be thoroughly cleaned at least once a month.

The ordinary privy-vault with porous walls is an abomination. It has caused more deaths in this country than war and famine have produced. The liquid poisons from it filter into wells, while its gaseous exhalations float through the air. People breathe and drink their own excretions, and typhoid fever and kindred diseases slay tens of thousands annually. It is safe to say that the privy-vault is the origin of the majority of the cases of typhoid fever. As the country becomes more thickly settled, the dangers from the privy-vault increase, and they should be wholly abandoned.

In many places it is the custom to move the privy, and cover the contents of the vault with a few shovels of dirt as soon as the vault is filled. In this way from one to half a dozen repositories of filth are formed in the average village back yard in a few years. Such a condition is certainly a highly unsanitary one.

The waste-pipes from the bath-tub and stationary wash-bowls should be well trapped, with the traps where they can be readily examined; and, as has been stated, these waste-pipes should have no connection, inside of the house at least, with the pipe from the water-closet. In the absence of sewage, the waste-pipes from the bath and bowls may be conducted into a cesspool. If the soil be gravelly, this cesspool should be lower than the bottom of the cistern, if the cistern be near. Its walls may be of stone or brick loosely laid, and a ventilating pipe should pass from the top of the cesspool, and extend at least ten feet above the surface. No kitchen or laundry waste should be allowed to pass into this cesspool. Since the water passing into this cesspool comes only from the bath and wash-bowls, it does not contain a great deal of organic matter, and will pass into the soil. The cesspool for the kitchen slops should be walled up and made water-tight. This cesspool should also be ventilated by means of a large vertical pipe. The top of this cesspool should have a man-hole in its centre, covered with a stone or iron slab, which can be removed in order to clean out the cesspool.

It is better for all pipes leading to sewers or cesspools to be disconnected, or furnished with gulley traps or with an air pipe just outside of

the house, in order to prevent the possibility of gas passing from the sewer or cesspool into the house. All cesspools should be as far from the house as possible, and they should be cleaned at regular intervals. The contents of the kitchen cesspool may be used for fertilizing.

All solid kitchen waste should be removed daily by a scavenger, who does this without expense to the householder, or it may be dried under the kitchen stove in shallow pans and then burned in the kitchen fire, or, if in the country, it may be fed to hogs or other animals.

The dust swept from the floor should be burned, not thrown out into the yard. Ashes should be kept in a dry place, and if so kept they may often be disposed of without cost. The soap-maker will pay for dry wood ashes, and coal ashes are often sought for and used for filling in low places. Each fire-place and grate should be furnished with an ash-pit in which the winter's product may fall, and by which accident from fire is greatly lessened.

When a house is built, a plan of all its drainage pipes should be made and preserved, as with it a faulty pipe or joint may often be found with ease, when without it much work may be necessary in order to find where the trouble is.

THE SURROUNDINGS.

It would be better if residences were not built up in solid blocks. Even narrow passage-ways between the houses, through which the air can move freely, are to be preferred to unbroken blocks. However, the price of land and of building material may compel some in the larger cities to deny themselves any further separation from their neighbor than that afforded by a single brick wall. But under no consideration should residences be built back to back, without any open space between the kitchens of the two houses. Even a few feet of open yard are of great benefit in affording ventilation, and in preventing excessive dampness. The yard should be kept scrupulously clean, and it should be rendered as beautiful as circumstances will permit. In summer there is no place for children in their play preferable to a nice spot out of doors.

The arrangement of cesspools, wells, cisterns, and out-houses has already been discussed. None of these should be allowed to contaminate the soil or air of the yard. Trees not too dense or too near the house are beneficial in shutting off dust, and tempering the heat of the summer's sun. Besides, no other ornament about the premises can be more attractive than beautiful trees.

The location of all the out-houses of the immediate neighbors, as well as those directly on the premises, should be taken into consideration. The yard should be so graded that the surface water will not collect about the foundations of the house.

A little care and a trifling expense in the surroundings will amply repay any family, and will increase one's love for what should be the dearest spot on earth—home.

THE CARE OF THE HOME.

Suppose that a location has been selected, a house built, and the surroundings prepared according to the foregoing directions, the next thing is to see that all is kept in a sanitary condition. Some families would convert the most scientifically constructed house into a den of filth. Cleanliness should be the watchword of every family. So far as sanitary needs are concerned, all the directions under this head might be condensed into the few words, "Keep everything clean."

Decaying vegetables must not be left in the cellar. Fresh air is to be admitted daily into every part of the house, from cellar to garret. Bedrooms especially are to be thoroughly aired. Refuse bits of food are not to be left to mold on the pantry shelf, nor should they be thrown out into the back yard. Better burn them. Offal from the preparation of food is not to be allowed to remain in the house, nor is it to be thrown out. It must be placed in the swill barrel, or burned. Dirty dishes are not to go unwashed, nor filthy floors unscrubbed, nor soiled linen unlaundered.

Fresh meat, milk, and other foods are not to be allowed to remain uncovered in living-rooms or bed-rooms. The flour-box is to be kept free, not only from the ravages of rats and mice, but from the dust of the room.

The drain from the ice-box should not be allowed to pass into a cesspool, sewer, or soil-pipe. Indeed, there should be no kind of connection between the ice-box, or other place in which food is kept, and any receptacle of waste matter.

The floors and seats of water-closets and earth-closets are to be kept clean. Drains and cesspools must be attended to. The supply of drinking-water must be kept free from every contamination.

Continued health is the reward for the care bestowed upon these details. The labor brings a rich return.

BUYING OR RENTING A HOUSE.

Great care should be exercised in renting or buying a house for family occupation. Many houses are now built purposely to rent or sell, and too many of these are constructed in a very flimsy manner. The object of the builder is to attract attention to his house, and money is spent in ornamentation, which should have been used in the more important parts of the structure. No one should place his family in a house until he has made a thorough investigation of its sanitary condition. The mere advertisement that "the house is furnished with the most approved sanitary appliances" should not be considered as a sufficient guaranty. Indeed, the statement of the owner or agent, that "everything is all right," is usually not to be relied on. The time will come when no one will be permitted to rent a death-trap in the shape of a house ; but, unfortunately at present, the duty of seeing that everything is really all right devolves

upon the person seeking a house. For this reason a few practical directions for house inspection may not be out of place here. The writer has known a man, even after having been warned by a former tenant, who placed his family in a house whose sole recommendation was its attractive appearance, and to regret his rashness a few weeks later when typhoid fever had stricken his family. The dangers to health and life are too great to allow any one to be careless or indifferent in this matter.

The house offered for rent or sale should be visited by the one seeking a home, and thoroughly inspected in regard to its sanitary condition, as well as to its general appearance. The surroundings should be studied. The condition of the back yard,—especially the location of out-houses on the premises and those of the neighbors,—the location and condition of cesspools, privy-vaults, cisterns, or wells, if such be present, should undergo careful inspection. What the sanitary arrangements should be has been already sufficiently indicated.

The cellar should be visited, and if its walls be cracked, damp, and covered with mold, if water stands upon its floor, and if light and ventilation are not provided for, seek some other habitation. It is better far to sleep in the open air, with no roof but the sky and no bed but a few blankets placed on the dry earth, than to live in a house built over a reeking cesspool; and such a cellar is nothing more nor less than a cesspool.

The general construction of the house should be closely scrutinized. Observe the height of the first floor above the level of the street, the proportion of the lot covered by the house, the arrangement and size of the rooms, and the condition of the floors, ceilings, and walls. Of course newly constructed walls are always damp. A great amount of water is used in the mortar and plastering, and much of this must evaporate before the building is fit for occupation. Neither should a house freshly painted with lead paints be occupied until the paint is well dried. The living-rooms should be placed upon the sunny, airy side of the house. The bed-rooms especially should be examined with reference to their size and means of ventilation. The floors should be of seasoned wood, well jointed. This is very desirable, as it prevents the accumulation of dirt under the floors, and permits of the free use of water in scrubbing the upper floors without danger of injury to the ceilings of the lower rooms.

"Skin" houses, put up by "jerry" builders simply to rent or sell at the highest price, can usually be recognized by careful inspection. Extra ornamentation will generally be observed, but, if a few months have elapsed since its construction, doors will be noticed not to close tightly, the wood-work is shrunken, the window-sashes do not move easily, and too frequently the foundations have settled and the walls cracked.

If the house be furnished with any plumbing, this should undergo thorough inspection. A map showing the distribution of the pipes, unless all are in plain view, should be furnished by the owner. In many old houses large brick drains are found in the cellar. These are always

bad. In them a great quantity of filth accumulates. They are seldom sufficiently flushed. Such a condition should lead one to reject a house for residence. If the drain in the cellar be of earthen pipe, its joints should be examined, for they are often imperfect, and allow of the escape of both gaseous and liquid contents. In this way the cellar floor becomes impregnated with filth, and from it noxious exhalations rise into the rooms above. The writer has known of more than one instance in which one of these drains has been broken by settling, and the consequence was that a regular cesspool was formed instead of the drain. In one instance the break occurred near a cistern, and much of the chamber and kitchen slops soaked through the imperfect cistern, polluting the water; and this was the probable cause of the typhoid fever which attacked four of the inmates of the house. Still worse is the box drain made of plank. Often at the junction of the vertical pipe with such a drain, the wood decays, and a filthy cesspool is formed.

Unfortunately in most cities the sewers pass along the street in front of the house, and the sewage is collected in the back part of the cellar, and carried by a drain under the floor for the entire length of the cellar, passing out under the front wall on its way to the sewer. The best place for the sewer is in the rear of the house, but when in front, the drain should be carried around the house; or, if through the cellar, it should consist of an iron pipe freely exposed along its entire length, and with sufficient fall to give a rapid current. Its grade should be uniform, and free from depressions in which accumulations might occur.

The proper arrangement of the soil pipe has already been referred to. It should be of iron, not of lead. Leaden soil-pipes are often corroded and leaky. The ventilation of the soil-pipe should be by means of a pipe extending above the roof. The water conductor from the roof should not be made to do service as a ventilating pipe. Moreover, when the rain-water conductor empties into the soil-pipe the force of the current through it will siphon the traps above unless they are all ventilated.

The location of all traps should be ascertained, and it should be seen that none of the pipes are either clogged or leaky. The desirability of the separation of the water-closet from the bath and wash-bowls has already been referred to. It is not desirable to have even stationary wash-bowls in bed-rooms.

If there be a water-supply, it is well to see, before renting or buying the house, that all the pipes are in good order and so protected that they will not freeze. If the drinking-water be stored in a tank, see that the tank is not lined with lead. All water pipes should be well supported, or they may sag and break.

The inspection of the method of heating and ventilating the building may be made from the rules in regard to these points already given. The same is true in regard to the disposal of garbage and the construction of earth-closets.

TENEMENT-HOUSES.

Every working-man should strive to secure a home, and the tenement-house can never be a home in any proper sense. The privacy and comfort of a home can never be secured in a tenement-house. Here people of all kinds are congregated, and the noise of the boisterous will disturb the rest of the quiet; the filth of the slovenly is likely to injure the health of those who endeavor to keep everything about them clean; and the habits of the immoral are distasteful to the moral. However, on account of poverty, many good people are compelled, for a time at least, to occupy rooms in a tenement-house. Unfortunately, the majority of such houses are built for the purpose of making as large pecuniary return to the owner as possible, and he cares but little about the character of his tenants or the manner in which they live, so long as their rent is paid. In the large tenement-houses of New York, all kinds of occupations are carried on, and many of them in the most slovenly manner.

The tenement should have a cellar under every part of it. The cellar should be divided into compartments by brick walls. No part of it should be used for sleeping-rooms, and it should be perfectly dry and well ventilated. The walls and floors throughout the building should be deadened. The halls should be lighted at both ends. They should be wide, and the space should not be encroached upon by using them as storage rooms.

Each water-closet should be thoroughly trapped and ventilated by a pipe extending above the roof. The ends of these pipes should not have return bends, nor be furnished with caps which are likely to obstruct the upward current.

The water-pipes from baths, stationary wash-bowls, laundry tubs, and sinks should have no connection with the water-closets, and should discharge into the open air outside the building over gullies, or should pass through air-traps outside of the house, the air-trap having a large ventilating pipe carried above the roof. In this way there will be no connection between the drain or sewer and the inside of the house, except through the ventilated soil-pipe of a trapped water-closet.

The floor and seat of every water-closet should be scalded with hot water and soap at least twice a week. There should be a separate closet for every fifteen persons.

The laundry work should be done in some special place, and not in the living- or sleeping-rooms. The water-supply should be abundant; and where the water-closets are used, not less than thirty gallons per day for each inmate of the house. Kitchens and bed-rooms should be separate. The minimum amount of cubic space allowed should be five hundred cubic feet per head, and this amount will answer only when ample provision for ventilation exists.

Each room should be lighted by outside windows or by light-shafts. The window sash should lower from the top as well as raise from the bottom. Each room must be furnished with a separate flue for ventila-

tion, or a foul-air shaft, which should be heated. These shafts may be heated by being placed in the same chimney with smoke flues, or in case the entire building is heated by steam, a number of foul-air shafts may be brought together in the attic, and heated by a steam coil. If this is done there should be no means of cutting off the steam from this coil. The method of removing foul air, by means of a large central shaft, may do when there are conductors leading from each room to such a shaft, but when it depends upon the foul air from distant rooms reaching the shaft by means of open doors or through transoms, it will often fail. Moreover, all attempts to ventilate a number of rooms on different floors through the same flue or shaft, it matters not how large it may be, will always prove more or less of a failure; because, on account of difference in temperature, the foul air from one room will often pass into another.

II.

HEALTHY FOODS.

FOODS AND FOOD-STUFFS.

Since particles of our bodies are constantly being worn away and cast out, new material must be introduced in order to make good the loss. Again: it is necessary that our bodies should be supplied with force or energy, that animal heat, muscular movement, and nervous activity may be maintained. For these reasons foods are taken.

Foods may be defined as substances which when taken into the body aid in building up or repairing tissue, or, by being oxidized or burned, generate force or energy.

Our ordinary foods consist of certain food-stuffs or elementary principles, together with a greater or less amount of wholly indigestible substances. Thus, oatmeal is a food containing the food-stuffs, gluten, starch, and fat, with a certain amount of cellulose (cell structure) which is of no service to the body. The nutritive value of a food depends upon the kind and amount of these food-stuffs that it contains. Since no satisfactory discussion of foods can be carried on until we become acquainted with those constituents upon which their values depend, we will briefly consider the food-stuffs. Fortunately they are not numerous, and may be divided into the following classes:

(1) Albumens or proteids.
(2) Fats or oils
(3) Starches or carbohydrates.
(4) Inorganic salts.
(5) Water.

Albumens or Proteids. To this group belong some of the most important food-stuffs. They all contain nitrogen, and for this reason the term "nitrogenous constituents" is used sometimes instead of proteids or albumens. The chief proteids are ordinary albumen, as the white of egg, casein of milk, fibrine of meat, gluten of grains and flour, and legumine of pease and beans. The amount of proteid in the different foods is variable;—thus, meat contains from 15 to 23 per cent.; milk from 3 to 4; pease and beans from 23 to 27; grains and flours from 8 to 11; bread from 6 to 9; and potatoes and greens from 1 to 4.

When we remember that the blood, muscles, and all the vital organs contain proteids as their chief constituents, we can understand the importance of taking food rich in one or more members of this group. The average working-man requires in his daily food the equivalent of four or five ounces of pure proteid.

The digestive and assimulative organs have the power of converting one proteid into another, but they are not able to form a proteid out of a fat or a starch. For this reason no other food-stuffs can, without injury, be a substitute for the proteids in our food for any length of time.

Fats. Fats when oxidized or burned in the body produce more force than will arise from the combustion of an equal weight of any other food-stuff. In cold countries the inhabitants instinctively consume large amounts of fat on account of the heat which is generated from it. The working-man requires not less than two ounces of fat per day. Fats are best digested when taken in a finely divided state.

Starches or Carbohydrates. To this group belong a number of substances of similar chemical composition, and the majority belong to vegetable foods. The most important are starch, sugar, gum, and dextrine.

Like the fats, they are consumed in giving energy to the body, though a much larger amount of the carbohydrates is required to yield the same result to the body. The daily need of this food-stuff by the average working man is between seventeen and eighteen ounces.

The cellulose or cell structure of plants is closely allied to the members of this group, and any cellulose that is absorbed must first be converted into sugar.

Mineral Salts. The bones of the adult man contain as much as 70 per cent. of mineral matter, the greater part of which is the phosphate of lime. Smaller quantities of the phosphate of magnesium and the carbonate of lime also exist in bones. The muscles, blood, and tissues also contain salts of potash and soda, and some iron. One of the most important mineral foods is common salt or the chloride of sodium.

Water. About 70 per cent. of the adult body is water. It forms the greater part of the vital fluid, in which it serves as the carrier of other substances, some in solution, others held in suspension. Besides the fluids, the solid tissues contain a greater or less proportion of water: the muscles contain as much as 75 per cent. There is also great loss of water by evaporation from the skin, by exhalation from the lungs, and by excretion from the kidneys and bowels. This loss must be made good by the drinking of water, and by taking foods more or less rich in this constituent. Meat contains about 75 per cent.; milk on an average, 87; bread, 35; and vegetables and fruits, from 70 to 90.

THE NUTRITIVE VALUE OF FOODS.

The nutritive value of a food will depend upon the proportion and kind of food-stuffs which it contains. However, there are many conditions which influence the nutritive value of a food. In order for this to be high, its constituents must not only be rich in food-stuffs, but they must be digestible. By improving the digestion, the appearance, odor, and taste of a food increase its nutritive value. A certain method of cooking makes a food more acceptable to one, while another is pleased with a wholly different manner of preparation. The taste and odor, when

pleasing, stimulate the flow of the digestive juices; and not only will more of the food be taken as a result, but a greater proportion of that which is taken will be digested and assimilated.

It is also quite essential that the volume of food taken should be large enough to satisfy the appetite, and still not so great as to prove burdensome. For this reason foods poor in certain food-stuffs are usually taken with some other food rich in these constituents. Thus, the potato, which contains not more than 2 per cent. of proteids, is usually eaten with meat, which contains from 14 to 21 per cent. of proteids; or we may say with equal propriety, that because meat contains no starch, man has learned to take with it the potato, whose chief constituent is starch. If one should attempt to live upon potatoes only, the weight of the food that he would have to take each day in order to get the minimum quantity of proteids upon which life could be sustained would not be less than ten pounds. Dr. Edward Smith actually found some of the poorest Irish laborers confined almost exclusively to potatoes, and consuming the amount given above. This would lead to distention of the digestive organs, and render one dull and stupid. The digestive organs of plant-eating animals form from 15 to 20 per cent. of the entire body weight. In flesh-eating animals the digestive organs form only from 5 to 6 per cent. of the body weight; in man the proportion is from 7 to 8 per cent. Thus, man, upon this point at least, holds an intermediate position between flesh-eating and plant-eating animals, being more closely allied to the former than to the latter. However, as the proper cooking of the food aids digestion, man may digest some of the vegetable food even more quickly and completely than the ox can. But his food should not consist wholly of vegetable products. A certain amount of animal food, while not absolutely necessary to the maintenance of life, is essential to man's highest development.

The nutritive values of the different foods, as shown by the per cent. of the various food-stuffs which they contain, will be given under the special description of each food.

THE ECONOMIC VALUE OF FOODS.

That food is most economical which contains the greatest amount of the most valuable food-stuffs for the least money.

The average working-man requires daily in his food, in round numbers, not less than four ounces of proteids, two ounces of fat, and eighteen ounces of carbohydrates. What combination of foods will furnish these for the least money? This is an important question; but in answering it, it should always be borne in mind that the foods suggested are to be healthy ones. A combination which would cost but little, but which would lead to dyspepsia or other ills, might in the end be quite costly.

The following formulas show some combinations, and give the approximate cost. It will be seen that the required amount, or more, of each food-stuff is present:

CLASS I.—*Very cheap daily rations without meat.*

No. 1.

	Proteids. Oz.	Fats. Oz.	Carbo-hydrates. Oz.	Cost. Cts.
26 oz. bread	1.82	0.13	14.35	5 at 5 cts. per loaf.
2 oz. oatmeal	0.29	0.12	1.30	½ at 4 cts. per lb.
1 pt. of milk	0.54	0.57	0.76	3 at 6 cts. per qt.
1 oz. sugar			0.94	½ at 8 cts. per lb.
24 oz. potatoes	0.48		4.96	1½ at 60 cts. per bush.
4 oz. beans	0.92	0.08	2.14	1 at 4 cts. per lb.
2 oz. lard		1.98		1¼ at 10 cts. per lb.
	4.05	2.88	24.45	12¾

No. 2.

	Proteids. Oz.	Fats. Oz.	Carbo-hydrates. Oz.	Cost. Cts.
26 oz. bread	1.82	0.13	14.35	5 at 5 cts. per loaf.
2 oz. fat cheese	0.50	0.58	0.04	1½ at 12 cts. per lb.
1 pt. milk	0.54	0.57	0.76	3 at 6 cts. per qt.
16 oz. potatoes	0.32		3.31	1 at 60 cts. per bushel.
4 oz. beans	0.92	0.08	2.14	1 at 4 cts. per lb.
1 oz. lard		0.99		⅝ at 10 cts. per lb.
1 oz. sugar			0.94	½ at 8 cts. per lb.
3 5-oz. cups tea				1 at 75 cts. per lb.
	4.10	2.35	21.54	13⅝

No. 3.

	Proteids. Oz.	Fats. Oz.	Carbo-hydrates. Oz.	Cost. Cts.
16 oz. bread	1.12	0.08	8.83	3 at 5 cts. per loaf.
4 oz. oatmeal	0.58	0.24	2.60	1 at 4 cts. per lb.
1 pt. milk	0.54	0.57	0.76	3 at 6 cts. per qt.
1 oz. sugar			0.94	½ at 8 cts. per lb.
32 oz. potatoes	0.64		6.62	2 at 60 cts. per bushel.
1 oz. lard		0.99		⅝ at 10 cts. per lb.
5 oz. fat cheese	1.25	1.45	0.11	3¾ at 12 cts. per lb.
	4.13	3.33	19.86	13⅞

No. 4.

	Proteids. Oz.	Fats. Oz.	Carbo-hydrates. Oz.	Cost. Cts.
16 oz. bread	1.12	0.08	8.83	3 at 5 cts. per loaf.
6 oz. oatmeal	0.87	0.36	3.90	1½ at 4 cts. per lb.
1 pt. milk	0.54	0.57	0.76	3 at 6 cts. per qt.
1 oz. sugar			0.94	½ at 8 cts. per lb.
4 oz. beans	0.92	0.08	2.14	1 at 4 cts. per lb.
32 oz. potatoes	0.64		6.62	2 at 60 cts. per bushel.
1 oz. lard		0.99		⅝ at 10 cts. per lb.
3 5-oz. cups tea				1 at 75 cts. per lb.
	4.09	2.08	23.19	12⅝

No. 5.

	Proteids. Oz.	Fats. Oz.	Carbo-hydrates. Oz.	Cost. Cts.
26 oz. bread	1.82	0.13	14.35	5 at 5 cts. per loaf.
2 oz. rice	0.16	0.02	1.53	1 at 8 cts. per lb.
1 egg	0.12	0.12		1¼ at 16 cts. per doz.
1 oz. lard		0.99		⅝ at 10 cts. per lb.
4 oz. beans	0.92	0.08	2.14	1 at 4 cts. per lb.
4 oz. fat cheese	1.00	1.16	0.08	3 at 12 cts. per lb.
	4.02	2.50	18.10	11⅞

No. 6.

	Proteids. Oz.	Fats. Oz.	Carbo-hydrates. Oz.	Cost. Cts.
26 oz. bread	1.82	0.13	14.35	5 at 5 cts. per loaf.
1 oz. macaroni	0.09		0.76	1¼ at 20 cts. per lb.
4 oz. beans	0.92	0.08	2.14	1 at 4 cts. per lb.
32 oz. potatoes	0.64		6.62	2 at 60 cts. per bushel.
1 oz. lard		0.99		⅝ at 10 cts. per lb.
4 oz. fat cheese	1.00	1.16	0.08	3 at 12 cts. per lb.
1 oz. sugar			0.94	½ at 8 cts. per lb.
3 5-oz. cups of tea				1 at 75 cts. per lb.
	4.47	2.36	24.89	14⅜

Although the rations suggested in the preceding tables do not contain meat, they do contain more or less animal food, and are healthy. However, the writer would not recommend one to adhere constantly to them, as some meat, while not necessary to health, does undoubtedly increase bodily vigor.

The small amount of really nutritive matter in tea is not considered, and the reader is referred to the articles "Tea" and "Coffee" for a true explanation of the food values of these drinks.

It will be seen that among vegetable foods in common use, oatmeal, beans, and potatoes are the cheapest. Since the prices vary so greatly, not only at different times, but in different parts of the country at the same time, the price at which the computation is made is given in each instance; and if the prevailing price differs from that given, any one can ascertain the change that would be produced in the total cost of the daily rations.

CLASS II.—*Very cheap daily rations with meat.*

No. 1.

	Proteids. Oz.	Fats. Oz.	Carbo-hydrates. Oz.	Cost. Cts.
26 oz. bread	1.82	0.13	14.35	5 at 5 cts. per loaf.
2 oz. codfish	1.60	0.02		1¼ at 10 cts. per lb.
2 oz. lard		1.98		1¼ at 10 cts. per lb.
16 oz. potatoes	0.32		3.31	1 at 60 cts. per bushel.
1 pt. milk	0.54	0.57	0.76	3 at 6 cts. per qt.
1 oz. sugar			0.94	½ at 8 cts. per lb.
3 5-oz. cups tea				1 at 75 cts. per lb.
	4.28	2.70	19.36	13 cts.

No. 2.

	Proteids. Oz.	Fats. Oz.	Carbo-hydrates. Oz.	Cost. Cts.
16 oz. bread	1.12	0.08	8.83	3 at 5 cts. per loaf.
1 oz. codfish	0.80	0.01		⅝ at 10 cts. per lb.
1 oz. lard		0.99		⅝ at 10 cts. per lb.
32 oz. potatoes	0.64		6.62	2 at 60 cts. per bushel.
2 oz. bacon	0.29	0.75		1½ at 10 cts. per lb.
4 oz. beans	0.92	0.08	2.14	1 at 4 cents per lb.
1 pt. milk	0.54	0.57	0.76	3 at 6 cts. per qt.
1 oz. sugar			0.94	½ at 8 cts. per lb.
3 5-ounce cups tea				1 at 75 cts. per lb.
	4.31	2.48	19.29	13¼

No. 3.

26 oz. bread	1.82	0.13	14.35	5 at 5 cts. per loaf.
2 oz. oatmeal	0.29	0.12	1.30	½ at 4 cts. per lb.
1 pt. milk	0.54	0.57	0.76	3 at 6 cts. per qt.
1 oz. sugar			0.94	½ at 8 cts. per lb.
2 oz. codfish	1.60	0.02		1¼ at 10 cts. per lb.
8 oz. potatoes	0.16		1.65	½ at 60 cts. per bushel.
2 oz. lard		1.98		1¼ at 10 cts. per lb.
3 5-oz. cups tea				1 at 75 cts. per lb.
	4.41	2.82	19.00	13

No. 4.

26 oz. bread	1.82	0.13	14.35	5 at 5 cts. per loaf.
1 oz. codfish	0.80	0.01		⅝ at 10 cts. per lb.
2 oz. lard		1.98		1¼ at 10 cts. per lb.
6 oz. beans	1.38	0.12	3.21	1½ at 4 cts. per lb.
2 oz. fat cheese	0.50	0.58	0.04	½ at 12 cts. per lb.
1 pt. milk	0.54	0.57	0.76	3 at 6 cts. per qt.
1 oz. sugar			0.94	½ at 8 cts. per lb.
3 5-oz. cups tea				1 at 75 cts. per lb.
	5.04	3.39	19.30	13⅜

No. 5.

26 oz. bread	1.82	0.13	14.35	5 at 5 cts. per loaf.
2 oz. fat cheese	0.50	0.58	0.04	1½ at 12 cts. per lb.
2 oz. bacon	0.29	0.75		1½ at 12 cts. per lb.
4 oz. beans	0.92	0.08	2.14	1 at 4 cts. per lb.
1 pt. milk	0.54	0.57	0.76	3 at 6 cts. per qt.
1 oz. sugar			0.94	½ at 8 cts. per lb.
3 8-oz. cups coffee				2 at 27 cts. per lb.
	4.07	2.11	18.23	14½

No. 6.

	Proteids. Oz.	Fats. Oz.	Carbo-hydrates. Oz.	Cost. Cts.
26 oz. bread	1.82	0.13	14.35	5 at 5 cts. per loaf.
2 oz. codfish	1.60	0.02		1¼ at 10 cts. per lb.
1 oz. bacon	0.14	0.37		¾ at 12 cts. per lb.
2 oz. lard		1.98		1¼ at 10 cts. per lb.
16 oz. potatoes	0.32		3.31	1 at 60 cts. per bushel.
½ pt. milk	0.27	0.28	0.38	1½ at 6 cts. per qt.
1 oz. sugar			0.94	½ at 8 cts. per lb.
3 8-oz. cups coffee				2 at 27 cts. per lb.
	4.15	2.78	18.98	13¼

Class III.—*Moderately cheap daily rations.*

No. 1.

	Proteids. Oz.	Fats. Oz.	Carbo-hydrates. Oz.	Cost. Cts.
16 oz. bread	1.12	0.08	8.83	3 at 5 cts. per loaf.
8 oz. beef (very fat)	1.36	2.12		8 at 16 cts. per lb.
32 oz. potatoes	0.64		6.62	2 at 60 cts. per bushel.
2 oz. oatmeal	0.29	0.12	1.01	½ at 4 cts. per lb.
1½ pt. milk	0.81	0.85	1.14	4½ at 6 cts. per qt.
1 oz. sugar			0.94	½ at 8 cts. per lb.
	4.22	3.17	18.54	18½

No. 2.

26 oz. bread	1.82	0.13	14.35	5 at 5 cts. per loaf.
8 oz. beef (moderately fat)	1.68	0.45		9 at 18 cts. per lb.
16 oz. potatoes	0.32		3.31	1 at 60 cts. per bushel.
1½ pt. milk	0.81	0.85	1.14	4½ at 6 cts. per qt.
1 oz. butter		0.83		1½ at 24 cts. per lb.
	4.63	2.26	18.80	21

No. 3.

26 oz. bread	1.82	0.13	14.35	5 at 5 cts. per loaf.
4 oz. mutton (very fat)	0.60	1.44		4 at 16 cts. per lb.
4 oz. beans	0.92	0.08	2.14	1 at 4 cts. per lb.
1 qt. milk	1.08	1.14	1.52	6 at 6 cts. per qt.
	4.42	2.79	18.01	16

No. 4.

26 oz. bread	1.82	0.13	14.35	5 at 5 cts. per lb.
8 oz. mutton (moderately fat)	1.36	0.48		9 at 18 cts. per lb.
32 oz. potatoes	0.64		6.62	2 at 60 cts. per bushel.
½ pt. milk	0.27	0.28	0.38	1½ at 6 cts. per qt.
1 oz. sugar			0.94	½ at 8 cts. per lb.

	Proteids. Oz.	Fats. Oz.	Carbo-hydrates. Oz.	Cost. Cts.
2 oz. butter		1.66		3 at 24 cts. per lb.
3 8-oz. cups coffee				2 at 27 cts. per lb.
	4.09	2.55	22.29	23

No. 5.

26 oz. bread	1.82	0.13	14.35	5 at 5 cts. per loaf.
4 oz. pork (lean)	0.80	0.28		3 at 12 cts. per lb.
2 oz. fat cheese	0.50	0.58		1½ at 12 cts. per lb.
32 oz. potatoes	0.64		6.62	2 at 60 cts. per bushel.
½ pt. milk	0.27	0.28	0.38	1½ at 6 cts. per qt.
1 oz. butter		0.83		1½ at 24 cts. per lb.
3 8-oz. cups coffee				2 at 27 cts. per lb.
	4.03	2.10	21.35	16½

No. 6.

26 oz. bread	1.82	0.13	14.35	5 at 5 cts. per loaf.
2 oz. sausage (best quality) .	0.57	0.80		1¼ at 12 cts. per lb.
2 oz. oatmeal	0.29	0.12	1.30	½ at 4 cts. per lb.
4 oz. beans	0.92	0.08	2.14	1 at 4 cts. per lb.
1 oz. bacon	0.14	0.37		¾ at 12 cts. per lb.
1 pt. milk	0.54	0.57	0.76	3 at 6 cts. per qt.
1 oz. butter		0.83		1½ at 24 cts. per lb.
1 oz. sugar			0.94	½ at 8 cts. per lb.
3 5-oz. cups tea				1 at 75 cts. per lb.
	4.28	2.90	19.49	14½

CLASS IV.—*More expensive daily rations.*

No. 1.

	Proteids. Oz.	Fats. Oz.	Carbo-hydrates. Oz.	Cost. Cts.
16 oz. bread	1.12	0.08	8.83	3 at 5 cts. per loaf.
2 eggs	0.24	0.24		4 at 24 cts. per doz.
2 oz. butter		1.66		4 at 32 cts. per lb.
1 qt. milk	1.08	1.14	1.52	8 at 8 cts. per qt.
1 oz. bacon	0.14	0.37		¾ at 12 cts. per lb.
1 oz. string beans	0.03		0.06	2 at 32 cts. per lb.
8 oz. mutton	1.36	0.48		9 at 18 cts. per lb.
32 oz. potatoes	0.64		6.62	2 at 60 cts. per bushel
1 oz. sugar			0.94	½ at 8 cts. per lb.
1 oz. dried fruit	0.02		0.55	1¼ at 20 cts. per lb.
	4.63	3.97	18.52	34½

No. 2.

16 oz. bread	1.12	0.08	8.83	3 at 5 cts. per loaf.
2 oz. oatmeal	0.29	0.12	1.30	½ at 4 cts. per lb.
2 oz. sugar			1.88	1 at 8 cts. per lb.

	Proteids. Oz.	Fats. Oz.	Carbo-hydrates. Oz.	Cost. Cts.
1 pt. milk	0.54	0.57	0.76	3 at 6 cts. per qt.
1 oz. macaroni	0.09		0.76	1¼ at 20 cts. per lb.
8 oz. beef	1.68	0.44		9 at 18 cts. per lb.
32 oz. potatoes	0.64		6.62	2 at 60 cts. per bushel.
2 oz. salmon	0.32	0.11		1½ at 20 cts. per lb.
2 oz. butter		1.66		4 at 32 cts. per lb.
3 8-oz. cups coffee				2 at 27 cts. per lb.
	4.68	2.98	20.15	27¼

No. 3.

20 oz. bread	1.40	0.10	11.04	4 at 5 cts. per loaf.
4 oz. beef	0.84	0.22		4½ at 18 cts. per lb.
2 oz. butter		1.66		4 at 32 cts. per lb.
2 oz. fat pork	0.29	0.75		1½ at 12 cts. per lb.
2 oz. beans	0.46	0.04	1.07	½ at 4 cts. per lb.
2 oz. starch			1.67	2 at 16 cts. per lb.
2 oz. sugar			1.88	1 at 8 cts. per lb.
2 oz. dried fruit	0.05		1.11	2½ at 20 cts. per lb.
8 oz. potatoes	0.16		1.65	½ at 60 cts. per bushel.
8 oz. lean mutton	1.36	0.48		8 at 16 cts. per lb.
3 8-oz. cups coffee				2 at 27 cts. per lb.
½ pt. milk	0.27	0.28	0.38	1½ at 6 cts. per qt.
	4.83	3.53	18.80	32

No. 4.

20 oz. bread	1.40	0.10	11.04	4 at 5 cts. per loaf.
2 oz. oatmeal	0.29	0.12	1.30	½ at 4 cts. per lb.
1 qt. milk	1.08	1.14	1.52	6 at 6 cts. per qt.
2 oz. sugar			1.88	1 at 8 cts. per lb.
2 oz. butter		1.66		4 at 32 cts. per lb.
2 oz. mackerel	0.46	0.13		1½ at 12 cts. per lb.
8 oz. chicken	1.86	0.19		12½ at 25 cts. per lb.
16 oz. potatoes	0.32		3.30	1 at 60 cts. per bushel.
8 oz. fruit (as apple sauce)			0.80	1 at $1 per bushel.
	5.41	3.34	19.84	31½

No. 5.

26 oz. bread	1.82	0.13	14.35	5 at 5 cts. per loaf.
2 oz. sausage	0.57	0.80		2 at 16 cts. per lb.
2 oz. butter		1.66		4 at 32 cts. per lb.
8 oz. lean beef	1.68	0.08		9 at 18 cts. per lb.
16 oz. potatoes	0.32		3.30	1 at 60 cts. per bushel.
2 oz. macaroni	0.18		1.53	2½ at 20 cts. per lb.
1 qt. milk	1.08	1.14	1.52	6 at 6 cts. per qt.
2 oz. sugar			1.88	1 at 8 cts. per lb.
3 8-oz. cups coffee				2 at 27 cts. per lb.
	5.65	3.81	22.58	32½

No. 6.

	Proteids. Oz.	Fats. Oz.	Carbo-hydrates Oz.	Cost. Cts.
26 oz. bread	1.82	0.13	14.35	5 at 5 cts. per loaf.
2 eggs	0.24	0.24		4 at 24 cts. per doz.
2 oz. butter		1.66		4 at 32 cts. per lb.
8 oz. lean beef	1.68	0.08		9 at 18 cts. per lb.
2 oz. beans	0.46	0.04	1.07	½ at 4 cts. per lb.
1 oz. bacon	0.14	0.37		¾ at 12 cts. per lb.
16 oz. potatoes	0.32		3.30	1 at 60 cts. per bushel.
1 oz. sugar			0.94	½ at 8 cts. per lb.
1 pt. milk	0.54	0.57	0.76	3 at 6 cts. per qt.
3 8-oz. cups coffee				2 at 27 cts. per lb.
	5.20	3.09	20.42	29¾

To the cost of the raw food, as given in the preceding tables, is to be added the cost of cooking, fuel, keeping the table, and of furnishing seasoning, such as salt, pepper, and mustard. Where six or more persons eat together, the cost of the above items, including enough to pay the wages of the cook and waiters, is from 35 to 50 cents per week for each boarder. This increases the daily cost of board by from 5 to 7 cents above the figures given in the tables.

ANIMAL FOODS.

MEATS—GENERAL PROPERTIES.

A large proportion of our daily food consists of material derived from the animal world. Other animals take vegetable food and build it up, so that it approximates in physical and chemical properties the flesh of man. Of the foods thus derived from the animal kingdom, meat is one of the most important. Meat consists of different food-stuffs, as water, mineral salts, albumen, and fat. On an average, 100 parts of beef consist of 72 parts of muscle, 8 parts of fat, and 20 parts of bone (including cartilage and tendon). The age of the animal, and the manner in which it has been fitted for market, have a marked effect upon the composition of the flesh. Veal contains 3 per cent. more of water, and a corresponding amount of solid substance, than lean beef. Fat beef may contain as much as 10 per cent. less of water than lean beef. The same is true of the difference between mutton and lamb. Of all the kinds of flesh eaten, fat bacon contains the least amount of water. The average per cent. of water in bacon is 60, while that in lean beef is 75. The flesh of wild fowl, chickens, and pigeons furnishes on an average 77 per cent. of water. Fish is especially rich in water, the carp yielding 80 per cent. The fat in lean beef, veal, and mutton may be as low as from 1 to 1½ per cent., while that of fat beef is 14, of fat mutton 9, veal 6, and bacon 24. Along with these variations in the amounts of water and fat there are corresponding changes in the quantity of nitrogenous material. As a rule,

fish is poorest in nitrogenous substance, the per cent. in carp and salmon being 13, in pickerel 15; fat veal, mutton, and bacon, 15; fat beef, 16; lean beef, 22.

The following rules may govern us in the selection of meats:

Good beef has a reddish-brown color, and contains no clots of blood. Well nourished beeves furnish a flesh which while raw is marbled with spots of white fat; it is firm and compact. Old, lean animals furnish a flesh which is tough, dry, and dark; the fat is yellow. Veal is slightly reddish, and has tender, white fibres. The fat is not distributed through the lean, as in beef. The same is true of mutton. In well nourished animals, white fat accumulates along the borders of the muscles.

Pork is rose-red, and has fat distributed through the muscle. The lard is white, and lies in heavy deposit under the skin. The flesh of an old boar is dark, and often has an unpleasant odor and taste.

Good beef is not of a pale pink color, and such a color indicates that the animal was diseased. Good beef does not have a dark purple hue, for this color is evidence that the animal has not been slaughtered, but has died with the blood in its body, or has suffered from some acute febrile affection.

Good beef has no, or but little, odor; or if any odor is perceptible it is not disagreeable. In judging as to the odor of meat, pass a clean knife, which has been dipped in hot water, through it, and examine subsequently as to the odor of the knife. Tainted meat often gives off a plainly perceptible and disagreeable odor while being cooked.

Good meat is elastic to the touch. Meat that is wet and flabby should be discarded. It should not become gelatinous after being kept in a cool place for two days, but should remain dry on the surface and firm to the touch.

The flesh of young animals is more tender than that of the adult, but experiment, as well as experience, has shown that the former is less easily digested. For instance, veal and lamb are less easily digested, and tax the stomach of the dyspeptic more than beef and mutton. Dr. Smith has shown that this is largely due to the fact that the flesh of young animals cannot be perfectly masticated. The tissues of the young animal are less stimulating, less nutritious, and more gelatinous than the tissues of the adult animal. On the other hand, it is well known that an animal may be so old and poorly nourished that its flesh well-nigh defies both mastication and digestion. The common breeds of cattle are best fitted for the market at the age of 7 years; the better breeds earlier.

It makes a difference whether the special meat be served in or out of season. Beef is in highest season in the early months of winter, after the animal has been furnished abundant pasturage, though not absolutely out of season at any time of the year. Fresh pork is wholly out of season during the hot months of summer. Christison found in salmon, before the spawning season, 18.5 per cent. of fat and 39 per cent. of solids; after the spawning season, 1 per cent. of fat and 20 per cent. of solids.

In most cases, animals are fattened for the table. Some fat is desira-

ble, as it renders the meat more juicy, and develops an agreeable flavor. But the process of fattening is often carried too far. Fat should be taken in a finely divided state, for when swallowed in lumps it is well-nigh indigestible. Many a child, which has been reproved for refusing to eat fat meat, will readily take the same amount of fat, as butter, spread upon bread. The manner in which the animal has been killed affects the meat. Slaughtering is usually so conducted as to remove as much as possible of the blood. Either death is produced by the withdrawal of blood, or the blood is withdrawn as soon as possible after death. The removal of the blood enables the meat to be kept with more ease; it also improves the flavor.

In warm countries meat is often cut from the animal and cooked as soon as death is produced, and before *rigor mortis* (the stiffness of death) sets in. While the rigor is on, the meat is more difficult of mastication and digestion. In temperate latitudes the flesh is usually kept until this rigidity naturally passes off. This may be aided by pounding the meat after it has been cut into thin pieces. With us, the only animals which are cooked before rigor sets in are fish, frogs, some mollusks, frequently domestic fowls, and sometimes wild game.

The flesh of wild animals is richer in nitrogen and flavor, and contains less fat, than that of the same species kept in domestication.

Meat which has been frozen decomposes easily after being thawed out, and when cooked it is dry and insipid.

The ancient Egyptians and Chaldeans were acquainted with the fact that the flesh of diseased animals might harmfully affect those eating of it, and among them the use of such flesh as food was prohibited. The strictest measures were taken to see that the meat furnished their kings and priests was obtained from healthy animals. Even during the dark ages this prohibition of the use of flesh from diseased animals continued. During the eighteenth century, however, it was found that the inhabitants of besieged towns ate of such food when starvation threatened them, and without any marked detriment to health. The flesh of a diseased animal does not necessarily convey the malady to the consumer; but in order to prevent such transmission the cooking must be thorough. That phthisis (consumption) may be imparted to dogs by feeding them upon tubercular flesh has been proven experimentally. Dr. Livingston states that the use of the flesh of animals afflicted with pleuro-pneumonia produces carbuncle. In Germany and France many cases of anthrax or malignant pustule in man have arisen from partaking of the flesh of animals with this disease. The flesh of sheep with the small-pox, and of oxen with the cattle plague, has affected those partaking of it. Then there are the parasites, trichinæ, cysticerci (in "measly" meat), and echino-cocci (flukes), which may be transmitted to man. If every part of the meat be raised to a temperature of 160° Fahr. during cooking, these parasites are destroyed; but if the blood-red juices exude from the interior of the piece of meat on being cut, the parasites, if present, may still retain their vitality.

The eating of the flesh of diseased animals is admissible only when no better food can be secured, and when starvation threatens. The sale of such meat is prohibited by law, and any one guilty of such an outrage should be punished to the fullest extent.

The flesh of a healthy animal may become poisonous from partial decomposition. By the putrefaction of albuminous substances, certain organic poisons are generated. The symptoms produced resemble those of severe cholera morbus, and a fatal termination is not infrequent. These cases most frequently arise from eating sausage and canned meats, though they may be due to any meat which is partly putrid.

Gerlach, director of the Royal Veterinary School at Berlin, gives the following list of meats which should not be eaten:

(1) The flesh of all animals which have died of internal diseases, or which have been killed while suffering from such diseases, and of healthy animals which have been killed by over-driving;

(2) The flesh of animals with contagious diseases which may be transmitted to man;

(3) The flesh of animals which have been poisoned;

(4) The flesh of animals with severe infectious diseases, such as blood poisoning;

(5) Flesh which contains parasites that may be transmitted to man;

(6) All putrid flesh.

METHODS OF COOKING MEAT.

In boiling meat, if it is desired to retain the juices, the piece should be large, and should be placed at once in boiling water, and the boiling continued for five minutes. Then the temperature of the water should be allowed to fall to 160° Fahr., at which point it should be maintained until the meat is done. The boiling water coagulates the outside of the meat, and thus prevents the escape of the juices. If the temperature be kept at or near the boiling point throughout the process, the flesh shrinks, becomes tough, loses in flavor, and is finally digested with much difficulty.

On the other hand, if the object of the boiling is to make a good soup, the meat should be cut into small pieces, placed in cold water, and the temperature gradually raised to from 150° to 160° Fahr. Chicken broth is the most nutritious; mutton next; while beef makes a very weak broth. By boiling, meat loses, as a rule, from 25 to 30 per cent. of its weight.

In roasting, the oven should at first be very hot; then it should be cooled down, and the process continued at a low temperature. Since the heat applied to every portion of the outside of the meat cannot be so uniform in roasting as in boiling, the loss is usually greater in the former than in the latter.

Stewed meat is that roasted in its own juices. The meat is cut into small pieces, and the cooking should be carried on at as low a temperature as possible. The extracted matter should be served with the meat.

Often vegetables are stewed with the meat, thus improving the flavor of the former.

Proper cooking renders the meat more agreeable to the senses of sight, smell, and taste, and thus through the nervous system it stimulates the flow of the digestive fluids. One of the most fruitful sources of error in the cooking lies in using too high a temperature.

BRIEF CONSIDERATION OF THE MEATS IN COMMON USE.

Beef. Among all civilized people beef is regarded as the principal animal food. By common consent we admit that beef is more nutritious than any other kind of flesh. This universal opinion is supported by the investigations of science. There is a larger proportion of nutritious material in beef than in the flesh of the sheep or hog. Beef is of closer texture, and is fuller of red-blood juices. It is richer in flavor than the flesh of any other domestic animal, and a smaller amount of it will satisfy hunger. Siegert gives the following figures, showing the average per cent. composition of the flesh taken from different parts of a lean and a fat ox:

	Lean Ox.			Fat Ox.		
	Neck.	Sirloin.	Shoulder.	Neck.	Sirloin.	Shoulder.
Water,	77.5	77.4	76.5	73 5	63.4	50.5
Fat,	0.9	1.1	1.3	5.8	16.7	34.0
Muscle,	20.4	20.3	21.0	19.5	18.8	14.5

On an average, 65 per cent. of the live weight of an ox may be converted into salable meat, the exact proportion varying with the degree to which the animal has been fattened. The greater the amount of fat, the less the proportion of bone and other waste.

Not only does beef from different animals differ in composition, flavor, and digestibility, but that from various parts of the same animal varies. The flesh from the different parts of the carcass is divided into the following four classes, according to quality:

Class I. Porterhouse, sirloin, and best cuts from the rump: Price per pound, 15 cents.

Class II. Round, shoulder, ribs, top ribs, flank steak, plate, and skirt, 12½ cents.

Class III. Best parts of neck, brisket, and flank, 8 cents.

Class IV. Poorer parts of neck, flank, and brisket, 7 cents.

Pieces of shank and bone are usually sold by the piece, and not by the pound. The prices vary in different sections of the country and at different times, but the writer gives the above figures for the purpose of showing the difference in value of different parts from the same animal.

Veal. In many sections of the country calves of all ages are slaughtered. In some cities, as in Boston, the killing of a calf under one month of age for food is prohibited. It would be well if this law, or a more extensive one, should be enforced all over the country. Veal is too often used simply as a dish to please the taste. As has been remarked,

it is not nearly so nutritious as beef, and is much more difficult of digestion. Some persons are wholly unable to digest veal, and when they eat of it, it acts as a foreign body in the intestines, and causes griping and diarrhœa. Dr. Smith states that it is more easy of digestion when well roasted or broiled than when boiled. The time required for the digestion of veal is five hours or more, while beef is digested in from two and a half to three hours.

The mode of killing often practised in this case has a special influence on the nutritive value of the food. Veal is bleached by repeatedly bleeding the animal for some days, and at last allowing it to bleed to death. The bones of calves contain much animal matter, and for this reason they are used for the production of gelatine; and calves' feet are selected for the preparation of jellies, which are often very acceptable to the sick.

Mutton. This is more easily digested than beef, though in a healthy man no marked difference would be observed, since in the stomach of such a man there arises no inconvenience from the digestion of beef. However, mutton will be found to tax the stomach of the dyspeptic less than beef does, and mutton broth is both acceptable and valuable to a person suffering from dysentery or kindred affections of the bowels. But mutton is not so nutritious as beef.

In dressing a mutton, the woolly coat should not be allowed to touch the flesh. There is quite a perceptible difference in the flavor of mutton taken from a fattened wether, which has been for some time deprived of all excess in his woolly coat, and of that taken from a sheep which has a heavy fleece. The smallest proportion of both fat and bone to muscle is found in the leg; consequently this is the most valuable part of the animal.

Lamb. This is not nearly so nutritious as mutton. The tissue is soft, gelatinous, and rich in water. It is used principally on account of its delicacy of flavor, which, however, is very variable, depending upon the breed and nourishment. Lamb should not be selected for those whose digestive organs are weak.

Pork, *Bacon*, *and Ham.* As a rule, dried meats are more difficult of digestion than the same meats in the fresh state. Bacon and ham are, however, exceptions to this rule, for when well cured they are digested with more ease than fresh pork. In cold weather, nice bacon is especially suited for furnishing a large amount of heat by its oxidation in the body. The inhabitants of cold countries find fatty food necessary to their existence.

For several reasons, the flesh of the hog must continue to form one of the most important sources of our food. This animal can be fattened more readily and at less cost than either the ox or sheep. The best breeds of pigs store up in their bodies three times as much of the food which they eat as the ox does. Then the flesh can be cured easily and preserved indefinitely. Again, the animal multiplies rapidly and reaches maturity speedily.

On the other hand, of all the meats ordinarily eaten, this is most likely

to be diseased. "Measly" pork can, as a rule, be recognized by the unaided eye on close inspection. The meat is dotted with grayish-white specks, about the size of a pea; but "measly" pork is often cut up into sausage, in which the diseased condition escapes recognition. The "measles" (cysticerci), taken into the stomach of man, develop into tape worms. Then there are the trichinæ, which can be recognized only by the aid of the microscope. These little parasites penetrate the muscles of man, causing great suffering, which often terminates in death. These parasites occur so frequently in pork and its cured products, that every one should always remember that the flesh of the hog should not be eaten unless it has been thoroughly cooked. As we have stated, these parasites are destroyed if the temperature of every part of the meat be raised to 160° Fahr. during cooking.

Fowl. There is no bird that may not be eaten in case of necessity. In other words, the flesh of no bird is in itself poisonous. The same is true of the eggs of all birds. It is true that cases of poisoning from eating quails, during spring, have occurred; but the poisoning was due to the buds of the mountain laurel, upon which the birds fed. The flesh of carnivorous birds is strong in odor and in taste, and would not form a tempting dish, save to one threatened with starvation. The light meats of birds are more easily digested, less rich in nitrogen and in flavor, than the dark meats. Chicken broth is more nutritious than that made from either mutton or beef, and is often of great value to the sick.

Fish. Undoubtedly the flesh of some fish is poisonous. A fish is said to justify suspicion when it has attained a size unusual for one of its species. This popular idea may have a grain of truth in it. Fish should be discarded if the water in which it is being boiled blackens silver. The coloration is due to hydrogen sulphide (the gas of bad eggs), and indicates putrefactive changes. Decomposing fish has a pale look, and its belly is bluish. It is withered, sticky to the touch, and foul in odor. The seller sometimes tries to hide the evidence of decomposition by taking the eyeballs out and coloring the gills with blood. Fish caught from putrid water should not be eaten. Sometimes, near large manufacturing establishments where a great deal of refuse is thrown into the water, the fish are killed, and may be brought to market. The flesh of such fish is yellowish, soft, spongy, and of foul odor. Fish may be divided into those furnishing white and those furnishing red meats. Those of the former class, as the whitefish, are delicate and easy of digestion, while those of the second class are richer in nitrogen, and more stimulating. Fish should not be left in the water after they are dead, but should be packed in ice.

Fish should not be the chief flesh diet of a people, because it is not sufficiently stimulating. Indeed, it is doubtful if any class of people would voluntarily confine themselves to such food.

But the occasional use of fish forms a change which is both agreeable and beneficial. There is no truth in the popular idea that a fish diet is especially suited to the development of the brain and nervous system.

Along with fish are often classed certain crustaceans, as the crab and lobster, and certain mollusks, as the oyster and mussel. The oyster and mussel are gelatinous, but are easily masticated and digested. The lobster, crayfish, and crab are more muscular, and are somewhat more difficult of mastication and digestion. The nutritive value of the oyster is not very great, but its delicacy of flavor and ease of digestion make it of great value to all, and especially to the sick. The raw oyster is probably more easily digested than the cooked.

The crab and lobster are of considerable nutritive value, though, on account of price, they are used principally as delicacies.

Sausage. The food value of sausage depends upon the substances out of which it is prepared. If made from good meat it forms a very valuable preparation, as by this means all the small bits are collected and saved. But its method of preparation allows of the introduction of poor grades of flesh, and of several adulterations.

The adulterations which have been found in sausage are meal, to increase the bulk and the profit; salicylic acid and borax, to prevent decomposition; and a red coloring matter (fuchsin), to give the poorer quality of meat a better color. The liver sausage (leberwürste of the Germans) is made by grinding up liver, lungs, kidney, tendon, soft cartilage, and fat; sometimes meal is added. The so-called white sausage, which is used to some extent in this country, is made by mixing the crumbs of white bread with the meat. Blood or red sausage consists of a mixture of blood, fat, and flesh, with or without meal. Pea sausage is a well known preparation in France, where it is patented and warranted not to become rancid. It is of variable composition, but consists principally of ground pease with meat, and some preservative, as salicylic acid. The writer does not know of its introduction into this country.

Sausage poisoning, which is common and so often fatal in parts of Germany, is fortunately very rare in this country, though a similar affection from canned and dried meats is becoming too frequent. The poison is generated by partial decomposition. Sausage which has a putrid odor, or rancid taste, or has greenish or yellow spots in its interior, should not be eaten. Bad sausage, and other similar meat preparations, are usually, in the interior at least, soft and sticky, and when broken show small cavities. This is true even when the outside appears to be all right.

Meat Extracts. Liebig's meat extract, which is now so well known, is made by boiling lean meat with from eight to ten times its volume of water, removing the insoluble parts, fat and albumen, and evaporating to the consistency of a syrup. About thirty pounds of meat yield one pound of extract. Meat extracts are made on the largest scale in South America, from cattle which are wholly worthless for beef.

It will be seen that this extract consists only of those constituents of the meat which are soluble in water, and they are certain crystallizable organic bodies and the inorganic salts. All the really nutritive parts of the meat are insoluble in water, and are not, therefore, present in the extract. Liebig's extract and similar preparations are agreeable in

taste and odor, and are valuable stimulants, often improving the appetite, so that more valuable foods are demanded and digested. As stimulants, they are of great value to the sick; but some other food should also be supplied. A German deprived two dogs of all solid food, giving one only water, and the other meat extract. The one furnished with the extract lost flesh more rapidly than the other, and died first.

Beef-Tea. This should be prepared as follows: Cut the beef-steak into fine pieces. Put the chopped meat, *without any water*, into a small vessel, which is set into a kettle of warm water. Heat gradually, keeping the water in the kettle above blood-heat, but do not allow it to boil. Remove the small vessel containing the meat and the juice which has exuded from it, strain its contents, season, and serve.

As thus prepared, beef-tea is somewhat more nutritious than Liebig's extract; still, its chief value is to those who need a stimulant, and to those for whom a very small amount of food is sufficient.

Fluid Meats and Peptones. These are supposed to be formed by artificial digestion, whereby the same products are produced as in the stomach. The best of them are of value; others are worthless. They are to be regarded as medicines, and are to be used according to the directions of the physician.

Bone and Cartilage. Bone consists of a gelatine forming organic substance, and of mineral salts. Besides, the marrow contains considerable fat and a little albumen. About one third of bone is organic matter, a large part of which is soluble in boiling water. For this reason, bone is of value in making soups. The long bones are not acted upon by water readily, unless they first be cut or ground into small pieces. The bones of the spine and the ribs make a very nutritious soup, which yields as much as twenty-four per cent. of the weight of the bone in solid matter. Bones should be boiled for several hours, in order to get all the food-stuffs out of them. When we remember that these soups are also used for the purpose of serving vegetables, we may appreciate the real value of bone as a source of food.

MILK.[1]

Milk is a white, yellowish white, or bluish white fluid. It consists of a colorless fluid holding milk globules in suspension. These globules render the fluid opaque.

The reaction of fresh milk (cows') is sometimes alkaline, sometimes acid; but, as a rule, it gives both reactions, turning blue litmus paper red; and red litmus, blue.

Composition. Milk contains representatives of all the classes of food. The albuminous constituents are casein and albumen. The former is coagulated when the milk becomes sour, or on the addition of an acid, or by the action of rennet. The albumen is precipitated by heat. The

[1]As cow's milk is the only kind that is used as a commercial food in this country, all the statements made will refer to this kind unless some other kind be specified.

amount of casein is much larger than that of albumen. There is also a nitrogenous constituent which is not coagulated by either heat or acids.

The fat of milk forms butter, and the importance of this constituent is so great that we often decide as to the value of a given sample of milk from the amount of butter which it yields.

Milk sugar has the same chemical composition as cane sugar; but they differ somewhat in their physical properties.

If some milk be evaporated to dryness and the residue be burned, there remains a flaky, white ash, which contains all the inorganic salts which are absolutely necessary to the body.

The following table gives the average per cent. composition of milk:

Water.	Casein and Albumen.	Fat	Milk Sugar.	Ash.
87.5	3.5	3.5	4.8	0.7

Colostrum. The fluid which the cow yields directly after calving is known as colostrum, which differs essentially in composition from milk, and is unfit for human food. It gradually, however, approximates milk, and the change may be regarded as complete by the eighth or tenth day. The fat of colostrum is in large lumps, and it contains much more albumen than milk does. Its average composition is shown by the following figures:

Water.	Albumen and Casein.	Fat.	Milk Sugar.	Ash.
73.07	19.21	3.54	3.00	1.18

The Care of Milk. Milk should not be allowed to stand in copper, brass, or zinc vessels, nor in earthen vessels which are lined with lead glazing; for if the milk should become at all sour, traces of the metal may be dissolved in it. There is no objection to wooden vessels if they are kept scrupulously clean. But when emptied they should be scalded with boiling water, and then dried before they are refilled. There are also no objections to the best glazed earthen or to well tinned vessels.

Milk should not be allowed to stand uncovered in an occupied room, especially in a sitting- or a bed-room. The fluid rapidly absorbs gases which may set up putrefactive changes in it. Besides, the dust which falls into it may contain disease germs, and these, finding a suitable place for their development, may multiply rapidly. There can be no question that milk has often served as the vehicle for distributing the germs of scarlet fever and diphtheria, which have fallen into it, or have been introduced with the water which has been used in diluting the milk, or for washing the vessels in which it is carried.

Souring of Milk. This fluid, on standing, sooner or later becomes distinctly sour, and its casein is coagulated. This is due to the action of a ferment, which is always present in the milk, on the milk-sugar, which is converted into lactic acid. The coagulated casein is known as "clabber," and the fluid portion forms whey. The best method of retarding the souring process in milk consists in keeping it in a cool place.

Boiling has a similar effect, but it alters the nature of the fluid more or less. Milkmen sometimes add bicarbonate of soda to milk to prevent its souring. The alkali simply neutralizes the acid as fast as it is formed.

Adulterations. While a great deal that is sensational has been said about the adulterations of milk, these frauds are perpetrated too frequently. A food which forms the principal, and in many instances the sole, sustenance of children, should be kept free from any adulteration which in any way lessens its nutritive value. To furnish a child with watered milk is often to slowly starve it to death, and the person guilty of such an act should be treated as a criminal.

The adulterations practised in the sale of milk are as follows:

(1) The addition of water, (2) the removal of more or less of the cream, (3) the addition of some foreign solid substance to increase the opacity or density of the fluid.

The addition of water is the fraud most commonly practised. The amount added varies from ten to fifty per cent. of the milk; though the former figure is probably the one most frequently approximated. Several states have laws defining the amount of milk solids, which must be present. Wherever these laws are enforced they form a valuable protection to the consumer, and to honest dairymen as well. Unfortunately, there is no ready test capable of being used by any one, by which the exact amount of water can be determined. The amount of cream which forms on a given volume of milk standing in a tall glass tube or other vessel is a rough but valuable method which every housewife may employ. From this she cannot say with certainty to her milkman that he has watered his milk, but she can tell him that the milk is not as rich as it should be.

However, it must be remembered that the cream rises on milk much quicker under some conditions than under others. Watery milk may be produced by feeding cows upon sloppy food, such as the refuse from breweries, as well as by the direct addition of water. Besides, watery milk often has a bluish color, and is not as opaque as healthy milk; though this appearance is sometimes hidden by the addition of a yellow coloring substance, annatto.

Skimmed milk is frequently sold for whole milk. In certain states there are very excellent laws against such a practice. The same rough test may be made as given above for watered milk. Sometimes skimmed milk is added to an unskimmed portion, and then sold as whole milk.

The addition of foreign solids is not frequently resorted to. The most common substance used is bicarbonate of soda for the purpose of preventing the souring of the milk, as has already been stated. In the amount used, it does not affect the food value of the milk. It is frequently said that chalk, gypsum, and gum arabic are added to milk. They may be used occasionally; but stupid indeed must be the consumer who would not detect these substances, which, on account of their insolubility, would be deposited in the vessel. It has also been stated that the brains of calves and other animals are pulverized or ground fine, and placed in

milk. This is an adulteration found in sensational books, but not in milk.

Diseased Milk. There can be no question about the possibility of the transmission of certain diseases from the lower animal to man through the use of milk as a food. In inflammation of the udder, the secretion of the gland is diminished, and the act of milking causes the animal much pain. The milk is of unpleasant odor, and contains lumps of coagulated casein and albumen, and sometimes blood and pus. Such milk may cause irritation and even inflammation of the stomach in children. In all acute febrile diseases of cows the amount of the secretion is diminished, and in severe fevers the flow of milk ceases altogether. In chronic diseases, as those of the digestive organs, the milk becomes thin and watery.

The cause of the disease known as milk-sickness, which has prevailed in certain parts of Illinois, Indiana, Kentucky, Tennessee, Georgia, and some other states, has never been ascertained. Some ascribe it to plants which the cows eat; others are equally certain that the drinking water is the source. As the country becomes more improved, the disease appears less frequently. This would lead us to suppose that the poison is obtained from some native plant which is destroyed by cultivation of the soil.

Unfortunately, in many diseases of cows, during the first stages at least, the changes in the character of the milk are not sufficiently marked to be observed;—however, the following kinds of milk should be avoided:

(1) Milk which becomes sour and curdles within a few hours after it has been drawn, and before any cream forms on its surface. This is known in some sections as "curdly" milk, and it comes from cows with certain inflammatory affections of the udder, or with digestive diseases, or from those which have been over-driven or worried.

(2) "Bitter-sweet milk" is that whose cream has a bitter taste, is covered with "blisters," and frequently with a fine mold. Butter and cheese made from such milk cannot be eaten on account of the disagreeable taste.

(3) "Slimy milk" can be drawn out into fine ropy fibres. It has an unpleasant taste, which is most marked in the cream. The causes which lead to the secretion of this milk are not known.

(4) "Blue milk" is characterized by the appearance on its surface, eighteen or twenty hours after it is drawn, of small indigo-blue spots, which rapidly enlarge until the whole surface is covered with a blue film. If the milk be allowed to stand for a few days, the blue is converted into a greenish or reddish color. This coloration of the milk is due to the growth of a microscopic organism. The butter made from "blue milk" is dirty-white in color, gelatinous in consistency, and bitter in taste.

(5) "Barn-yard milk" is a term used to designate milk taken from unclean animals, or those which have been kept in filthy, unventilated stables. The milk absorbs and carries the odors, which are often plainly perceptible. Such milk may not be poisonous, but it is repulsive.

The Value of Milk as a Food. The importance of this article of diet can hardly be be over-estimated. For children, it is the mainstay. For adults, it is a substance palatable and easily digested. About two quarts of good rich milk per day will support life, even if no other food be taken. One sick with a wasting disease, such as typhoid fever, has his chances of recovery greatly increased if he takes milk with comfort and digests it with ease. For the infant, there is no other food which can fully supplant the milk of the mother. Physicians of large experience say that the chances of rearing a babe are 50 per cent. better when it is well supplied with healthy milk by its mother than when nourished by artificial preparations. Woman's milk contains less fat and casein, and more sugar, than the cow's milk. When it becomes absolutely necessary to substitute the latter for the former, the cow's milk should be diluted with one third its volume of warm water, and one half ounce of milk-sugar should be added to each pint. As the child grows older, the amount of water added should be diminished, until, at the age of six months, undiluted cows' milk may be used.

Condensed Milk. This is prepared by evaporating milk in a vacuum to one fifth its volume, or to the consistency of honey, placing it in cans, which are set in water, the temperature of which is raised to the boiling point, when the cans are sealed. Sometimes cane sugar is added after evaporation. When used, condensed milk is diluted with five times its volume of warm water. It forms a valuable substitute for fresh milk when the latter cannot be obtained. Its exact value will depend upon the quality of the milk used in its preparation. The three most prominent brands of this preparation used in this country are the Anchor, the Swiss, and the Anglo-Swiss. The writer has examined these, and found them all of good quality.

BUTTER.

Of all the fats, butter is the most palatable and most easily digested. Only when it is rancid does it lead to dyspepsia. It, like all other fats, should be taken in a finely divided state. Its food value is great, and the amount consumed per head daily is about one ounce.

Physical Properties. Good butter is of a pale yellow color, which is uniformly diffused through it. The exact color of butter varies with the food of the cow; but as a yellow butter is universally demanded in market, makers almost invariably use a preparation of annatto. This artificial coloration has been so long practised, and as the use of the coloring material is not detrimental to health, it may be regarded as a legitimate use. Good butter is free from rancid taste and odor. White lumps in butter are due to the coagulation of casein, from the milk becoming too acid, and its incorporation with the cream. When a watery fluid exudes from the freshly cut surface of butter, it is evidence that the buttermilk was not expressed as thoroughly as it should have been, or that water has been added for the purpose of increasing the weight.

Composition. The amount of water in butter will depend upon the

manner of preparation and the quantity of salt added. In some families an unsalted butter is used. This does not contain more than from 3 to 6 per cent. of water. But as a rule more or less salt is added in making the butter. This is done to insure the preservation of the fat, and most people consider such an addition an improvement to the taste. Good salted butter will not contain more than from 10 to 15 per cent. of water, while the poorer grades may contain as much as 28 per cent. This large amount is taken up only when boiling water is mixed with the fat, and then the whole allowed to cool.

The salt used in butter should be finely pulverized and thoroughly mixed with the fat. From 3 to 5 per cent. of salt is all that is needed for preservation, but in order to increase the weight, from 10 to 15 per cent. is sometimes added. Good butter contains from 85 to 90 per cent. of fat, and any which contains less than 82 per cent. may be considered as adulterated. The most common fraud in regard to the fat consists in the use of tallow and lard, which will be discussed under the heads of oleomargarine and butterine.

The greatest amount of casein permissible in butter is 2 per cent. If there be much more present, the butter is lumpy. There is now being sold to dairymen a recipe by which it is guaranteed that a given volume of milk will be made to yield 25 per cent. more of butter. The process consists in the coagulation of all the casein in the milk, and its incorporation with the fat. The product is really not butter at all, but an inferior soft cheese. An excess of casein in butter increases its liability to become rancid.

How to Take Care of Butter. Butter, like milk, takes up unpleasant odors: for this reason it should not be allowed to stand exposed to the air of occupied rooms, nor in other places that may become foul. When freely exposed to air butter becomes rancid: it should be tightly packed and covered. Warmth hastens rancidity: it should be kept in a cool place.

OLEOMARGARINE AND BUTTERINE.

Oleomargarine. This substance is now largely manufactured and sold in this country, generally under the name of butter, but sometimes under its proper name. It is made as follows: The best beef fat is cut from the carcass while it is still warm. All bloody portions, and those tainted in any other way, are rejected. The selected fat is placed in fresh cold water, in which it is both cooled and washed. It is then ground like sausage. Then it is heated from 160° to 180° Fahr., by which the oil is separated from the membranes. The oil, after being salted, is cooled, and then pressed. Then it is placed in milk, a preparation of annatto added, and the whole churned, when it is worked as butter. The temperature at which the oil is separated from the membrane should be as low as possible; but in practice it varies within large limits. Some manufacturers use a heat of only 120°, while others allow the temperature to run up to 200° F. The oil thus prepared is known to the trade as "butter oil."

Butterine. This is prepared by the mixture of "butter oil" obtained from beef fat, as in making oleomargarine, and a similar oil obtained from hog fat, and churning with milk. The oil from the lard is separated at a temperature not exceeding 120° F.

A great deal has been said against the use of these preparations as foods. Several states have laws which require that when such articles are sold, the buyer shall receive them from a vessel which is labelled with the word Oleomargarine, or Butterine, as the case may be, in letters one inch high, and the portion taken by the buyer shall be covered with a paper which also bears the true name of the fat. This law is certainly a just one, as every article of food should be sold under its proper name; and the price of good butter should not be demanded for these imitations. At least two states,—New York and Michigan,—have enactments which wholly forbid the manufacture and sale of these preparations. These laws are both unwise and unjust. Oleomargarine and butterine are valuable food-stuffs. They are not equal to the best grades of butter, but are far superior to the poor, partly rancid butter which is so generally sold in the large cities. As has been seen from the methods of preparation given above, only the very best pieces of fat can be used. Any fat which has an unpleasant odor, or is in the least degree foul, must be rejected, for there is no method known for removing the odor.

One of the greatest dietary needs of the working-man is a sufficient supply of an inexpensive, wholesome fat. This will be largely met by these artificial butters.

CHEESE.

Cheese is of considerable nutritive value, one pound containing as much nitrogen as two pounds of meat, and as much fat as three pounds of meat; but, as a rule, cheese is difficult of digestion, and can be taken only in small amount at a time. Moreover, the exact composition of cheese is quite variable. It is made both from whole and skimmed milk, and at present some is made from skimmed milk to which oleomargarine or butterine has been added. The dairyman skims his milk, making butter from the cream; then to the skimmed milk he adds the fatty preparation, and makes cheese. In this way the same milk is made to produce both butter and cheese. It is a popular idea, that while cheese itself is digested with difficulty, a small amount of it in the stomach aids the digestion of other substances. The experiments of Dr. Edward Smith have confirmed this belief. As digestion is partly due to fermentation, and since cheese contains certain ferments, the belief is not irrational; but when taken as an aid to digestion, the amount should be very small, not more than from one half to one ounce.

True cream cheese is made from whole milk, to which cream has been added; but what is ordinarily known as "cream cheese" is that made from unskimmed milk. In such a cheese, the proportional amounts of casein and fat are substantially the same as in good milk. Skimmed

milk cheese is not so nutritious and not so easy of digestion as that made from whole milk.

Cheese is almost universally colored with annatto, which, as it has been so long used and is not detrimental to health, may be regarded as a justifiable adulteration. Without it, cheese would be of a dingy-white color.

EGGS.

There is no bird whose eggs may not be eaten in case of necessity. However, the eggs of flesh-eating birds are of strong, unpleasant odor. Practically, our use of eggs as food is confined to those of the chicken, duck, Guinea hen, and goose. The exact taste of eggs is influenced largely by the food of the bird. The nutritive value of eggs is great, both on account of their chemical composition and their flavor. The average weight of hens' eggs is from 1½ to 2 ounces, the parts existing in the following proportions:

Shell, ...	11.5 per cent.
Albumen (white), ...	58.5 "
Yolk, ...	30.0 "

The white of the egg consists of water and albumen, with traces of inorganic salts and fat. The yolk contains from 30 to 32 per cent. of fat; so that, practically speaking, the fat is confined to the yolk. There is not much difference in the time required for the digestion of a raw egg and one which has its albumen coagulated by heat, but the latter is the more agreeable in flavor. A hard-boiled egg is digested with more difficulty than one rarely done.

Since eggs are most abundant and consequently cheapest during spring and summer, their preservation is of considerable importance. When left exposed to the air, germs pass through the shell and cause decomposition. Consequently, the object to be held in view in endeavoring to preserve them is to exclude the air. This may be done by placing them in lime-water; but in this way the shells are made very brittle, and many are broken in removing them. They may be dipped in mucilage, and then packed in salt. However, the most common method consists simply in packing them in salt alone, or in salt and lime. Some dip the eggs for a moment in boiling water, whereby the part of the white immediately in contact with the shell is coagulated.

Decomposed eggs will float in brine (made by dissolving one part salt in ten parts of water), while fresh eggs placed in the same solution will sink.

VEGETABLE FOODS.

CEREALS AND GRAINS.

The cereals used as food in this country are wheat, rye, oats, corn, and rice. The most important food constituents of the grains are starch,

proteids or nitrogenous substances, and the phosphates of the ash. They also contain small amounts of fat, sugar, gum, and mineral substances other than the phosphates.

Of all the grains, wheat is considered the most nutritious. Its exact composition varies slightly, according to climate, nature of the soil, and the fertilization employed. Its average per cent. composition is given in the following figures:

Water.	Proteids.	Fat.	Sugar.	Starch.	Cellulose.	Ash.
13.56	12.42	1.70	1.44	64.07	2.66	1.79

The nitrogenous substances consist of vegetable albumen, casein, and gluten. The last mentioned forms by far the greater part of the nitrogenous material. The ash may contain as much as 45 per cent. of phosphoric acid, which is combined with lime, magnesia, and potash. As a rule, the greater the amount of phosphoric acid in the ash of the wheat, the greater the amount of nitrogenous matter in the grain.

Rye does not differ greatly in its composition from wheat, as is shown by the following figures, which give the average of forty-four analyses collected by König:

Water.	Proteids.	Fat.	Sugar.	Gum.	Starch.	Cellulose.	Ash.
15.26	11.43	1.71	0.95	4.88	61.99	2.01	1.77

However, the gluten of wheat is superior in quality to that of rye. In those countries whose inhabitants are compelled to depend largely upon rye bread, there is much suffering at times from poisoning with ergot. Fortunately, this poison is not found to any extent in wheat.

Oat meal, which has been used as a food in Scotland for a long time, is now being largely consumed in the United States, and it is to be hoped that its use will become more universal. It is a highly nutritious, healthy, and cheap article of diet. The average composition of the grain is as follows:

Water.	Proteids.	Fat.	Sugar.	Gum.	Starch.	Cellulose.	Ash.
12.37	10.41	5.23	1.91	1.79	54.08	11.19	3.02

It will be noticed that the amount of fat is much larger than in wheat or rye. In the best specimens of the grain the fat may be as much as 8 per cent.

Corn is largely used in some of the Southern states, and, in the various ways in which the people know so well how to prepare it, it forms a most valuable food. The exact composition varies considerably with the variety of the plant and the soil on which it grows; but the following are the average figures:

Water.	Proteids.	Fat.	Sugar.	Gum.	Starch.	Cellulose.	Ash.
13.12	9.85	4.62	2.46	3.38	62.57	2.49	1.51

The greater part of the nitrogenous material consists of vegetable fibrine.

Rice grains have the following average composition:

Water.	Proteids.	Fat.	Starch.	Gum.	Cellulose.	Ash.
9.55	5.87	1.84	73.00	2.85	5.80	1.09

Since the per cents. of both proteids and fats are low, it must be regarded as the least nutritious of the grains here mentioned. However, its ease of digestion renders it valuable to the sick; and the fact that its heat-producing power is not so great as the other grains, adapts it to the inhabitants of warm countries.

Barley, which is so largely used by the Scandinavians, and millet, which is a staple food in India and some other warm countries, are so seldom used in this country as foods that an extended notice of them is unnecessary.

Buckwheat does not belong to the cereals, but to a wholly different class. However, as it is a food which is highly prized by many, it deserves mention. The plant soon reaches maturity, and may be grown upon poor, sandy soil, as well as upon richer ground. The average composition is shown by the following figures:

Water.	Proteids.	Fat.	Gum.	Starch.	Cellulose.	Ash.
12.63	10.19	1.28	2.85	69.30	1.51	2.24

The albuminous substances found in buckwheat differ materially from those present in the cereals. Its food value is not so great as that of wheat, rye, or oats.

FLOUR AND MEAL.

By grinding, the grains which have been described are converted into flour or meal. By this process the food material is better fitted for cooking, and is to some extent separated from the indigestible portions. A few simple rules will be given by which good flour or meal may be distinguished from the inferior grades:

(1) Good wheat flour is white, with only a faint yellow tint. It does not contain any bluish, grayish, or dark specks. It feels soft and dry to the finger, and when some is pressed in the closed hand, it forms a dry lump, which breaks down readily with the gentlest pressure. If it fails to form a lump when pressed in the hand, it contains too much bran, or some mineral adulteration has been added. When the finger is introduced vertically into good flour, the depression thus made remains; otherwise, there is too much bran present. The odor is fresh and pleasant, not musty. Neither with the unaided eye nor with a magnifying glass will any living bodies be found in good flour.

(2) Rye flour has a grayish tint, and a characteristic odor and taste. The other general properties are identical with those of wheat flour.

(3) The color of corn meal varies with the variety of corn from which it is prepared. It should feel perfectly dry and powdery. It does not "lump" when pressed in the hand, and it has a characteristic, pleasant odor. Corn meal, when decomposition has begun, has a rancid odor, and if some of it be placed upon a piece of moistened blue litmus paper (which can be obtained at any drug store), the color of the paper will be

changed to red. Good meal has no effect on the color of the litmus paper.

(4) Oat meal should be dry, and free from any disagreeable odor.

The Care of Meal and Flour. When exposed to the air, flour and meal absorb water, and this greatly increases their tendency to decompose. In moist flour the lower forms of life are likely to develop. Foi these reasons these preparations should be kept in well closed receptacles.

Adulteration. Fortunately, these foods are very rarely adulterated in this country. Since wires have been used so extensively for binding in the great wheat fields of the North-west, a small amount of iròn is found in flour, as an accidental adulteration. It is frequently stated that gypsum and other mineral substances are added to flour, but the writer has examined many hundred samples, and has never detected such an adulteration. It has also been stated that the so-called "patent flour" contains alum. This is certainly false. One of the writer's students examined twenty-three samples of "patent flour" obtained at different places, and failed to find any alum present. It may be possible that in some instances the cheaper flours or meals are added to wheat flour; but even this fraud, if practised at all in this country, is carried on to a very limited extent. The great abundance and low price of wheat would tend to make any adulteration profitless.

BREAD.

The cooking of his food is one of the earliest evidences of man's civilization, and with no other food has the process of cooking been so thoroughly developed as with the products obtained from the edible grains. The essential constituents of bread are flour, water, and salt. To these have been added, for the purpose of varying and improving the taste, one or more of the following substances: Milk, sugar, eggs, fats, etherial oils, and fruits. Civilized man, in every part of the world, employs some means of raising or leavening his bread. By this the taste is improved, and the crumb, being divided by the evolved gas, is more readily acted upon by the digestive juices. The methods of raising bread are as follows:

(1) By the Growth of Yeast. Yeast consists of microscopic vegetable organisms, which, when placed in a suitable medium, grow rapidly, producing alcohol and carbonic acid gas. The evolved gas, in attempting to rise, becomes entangled in the meshes of the dough, distending it and making it light. After the dough has risen sufficiently, it is placed in a hot oven to bake. The heat destroys the yeast plant, and thus prevents further fermentation. If the growth of the yeast be allowed to continue for too long a time, acetic, lactic, and butyric acids are formed, and such dough makes "sour bread."

(2) By Baking Powders. In the use of baking powders, the carbonic acid gas, necessary to render the dough light, is generated by chemical means. Baking powders consist of some alkaline carbonate,

as sodium bicarbonate, and some acid substance, such as the acid tartrate of potash (cream of tartar), together with a small amount of starch to keep the mixture dry. As long as the powder is perfectly dry no reaction occurs, but when it is dissolved in water in the dough, the acid acts upon the carbonate, liberating carbonic acid, which has the same effect in raising the dough as when it is produced by the growth of the yeast plant.

In baking powders, ammonium carbonate is sometimes used instead of sodium bicarbonate; and the acid tartrate may be replaced by the acid phosphate of lime. But the use of alum in baking powders is an adulteration which is injurious to health. It unites with the phosphates in the bread, rendering them insoluble, and preventing their digestion and absorption. In this way alum, when present, diminishes the nutritive value of bread.

A small amount of starch in baking powders is necessary to keep them dry, but too often the manufacturer adds as much starch as possible, and this should be considered as an adulteration.

(3) By Aeration. In some large bakeries carbonic acid gas, generated by the action of some acid on carbonate of lime, is forced under pressure into the dough, thus distending the mass; or the dough is kneaded with water which has been saturated with carbonic acid under pressure. When the gas is washed before being forced into the dough or water, this method is a very desirable one. But the cost and care of the special apparatus necessary will prevent the adoption of this method of raising bread, except in large bakeries and hotels.

General Properties of Good Bread. The general statements concerning bread refer to that made from wheat flour. Good bread has a thick, fragile crust, which is not burnt, and which forms from 25 to 30 per cent. of the weight of the loaf. The crumb is white, and filled with cavities, the partitions between which are easily broken down. These cavities should be distributed through every part of the crumb; otherwise, the bread is sodden and heavy, and decomposes quickly. The bread should be of a pleasant odor and taste. If the bread is acid, it was probably made from inferior flour.

Changes on Standing. On standing, bread gradually loses weight, by the evaporation of a part of its contained water, and becomes hard. The amount of water given off in a certain time will depend upon the size of the loaf and the nature and extent of the crust. Bread should not lose more than 3 per cent. of its original weight after four days. Stale bread when dipped in water and rebaked, or when steamed, becomes palatable, but never completely regains the properties of fresh bread. In stale bread, small living organisms are likely to develop. Some of them are poisonous. The white and orange-yellow moulds which form on stale bread are due to a poisonous growth. Sometimes blood-red spots appear in bread. These also are due to a microscopic growth.

Adulterations of Bread. Bread is not adulterated to any great extent in this country. The baker's loaf is usually of light weight. An excess

of water is often incorporated with the dough. This makes the bread sodden and heavy, and increases its liability to decompose. In some of the larger cities, mashed potato has been found worked into bread. This lowers the nutritive value of the article greatly. Alum is sometimes added directly to flour or dough, and is sometimes contained in the baking powder, as has been stated.

The Food Value of Bread. As has been remarked, the most important food constituents of the grains, and consequently of bread, are the proteids, starches, and ash. The amount of nitrogenous matter is too small for a perfect food, and for this reason bread is often taken with some other food richer in nitrogen, such as meat. Bread is also deficient in fat, and man instinctively takes some kind of fat, such as butter or bacon, along with his bread. Notwithstanding these imperfections, bread is a food of which we never tire, and the various ways in which it is prepared aid in sharpening the appetite. Besides, while some important food substances are not abundant in bread, all are present to a greater or less extent; and with the addition of a little more nitrogen in the shape of meat and fat, as butter or bacon, a perfect diet is secured.

PEASE AND BEANS.

Pease and beans belong to the leguminous seeds. They contain more nitrogenous matter or proteids than any other vegetable food. Not only is the amount of proteid greater than in wheat and other grains, but it is different in its properties. That of the grains is principally gluten, while that of pease and beans belong to the casein group. The former is more easily digested than the latter, pease and beans often causing disturbances in the stomach and bowels. The average composition of these foods is shown by the following figures:

PEASE.

Water.	Proteids.	Fat.	Starch.	Cellulose.	Ash.
14.99	24.04	1.61	49.01	7.09	3.26.

BEANS.

Water.	Proteids.	Fat.	Starch.	Cellulose.	Ash.
14.76	24.27	1.61	49.01	7.09	3.26

There is great difference between the digestibility in these substances in the green and in the dried state. Soft green pease tax the stomach but slightly. Dried pease and beans must be boiled slowly and for a long time; and if they are very old, they should be soaked for several hours, and then crushed before they are cooked. Hard water is to be avoided in cooking them, as the lime of the water forms an insoluble compound with the albuminous constituents of the seeds.

Ground pease and beans are used to some extent in this country. They form a part of some food preparations, such as pea-sausage (erbswürste of the Germans).

Food Value of Pease and Beans. The nutritive value of the seeds is considerable, but on account of the tax which they impose upon the digestive organs, they cannot be taken in large quantities. The deficiency of fat is usually supplied by serving these foods with bacon or other fatty food.

POTATOES.

Potatoes contain only about 25 per cent. of solids, four and five-tenths of which is starch. The per cent. of nitrogenous matter and fat is small as shown by the following figures, which give the average per cent. composition of potatoes:

Water.	Proteids.	Fat.	Starch.	Cellulose.	Ash.
75.77	1.79	0.16	20.56	0.75	0.97

Notwithstanding its comparatively small per cent. of solids, the potato will continue to be one of the most valuable foods. Its growth is not influenced by soil and climate to such an extent as that of the cereals. The yield of the potato per acre is greater than that of any other vegetable. It is preserved with ease for winter's use, and the raw material is fitted for the table with but little trouble and expense. It can be served in a great variety of ways, and with other foods. Its deficiency in nitrogenous matter and fat is made up by cooking it with meat. It is agreeable to the taste, and easy of digestion. New potatoes are said to be waxy, and not so easily digested as old, mealy ones. In order to retain the salts, potatoes should be cooked with their skins on. If boiled, they should at once be placed in hot water. If baked, the oven must be moderately hot.

Potatoes should be of fair size, firm, and free from mould. The sweet potato is similar in composition to the ordinary potato, and furnishes an agreeable substitute: but it is more expensive, and cannot be preserved so easily

OTHER VEGETABLES.

The other succulent vegetables which are used as foods are principally useful on account of furnishing variety, and for the acid salts which they contain, and whose use renders other foods more digestible, and prevents scurvy and kindred affections.

The beet root is not only a pleasant food, but furnishes as much as 10 per cent. of sugar, for which it is now largely grown; though the different varieties of the root vary considerably in the amount of sugar which they contain.

Turnips, carrots, and parsnips contain from 82 to 90 per cent. of water, from 5 to 10 per cent. of starch, from 2 to 6 per cent. of sugar, about 1 per cent. each of nitrogenous matter and salts, and ½ per cent. or less of fat.

Cabbage, turnip tops, spinach, water-cresses, dandelion, and other greens" should always be thoroughly cooked. The amount of absorbable food which they contain is generally less than 5 per cent.

The tomato, either raw or cooked, furnishes an agreeable sauce. It is also used for making soup and for flavoring meat soups. It contains over 92 per cent. of water, less than 2 per cent. of starch, and about $2\frac{1}{2}$ per cent. of sugar.

Rhubarb is a pleasant, acid vegetable, which is especially serviceable on account of its being one of the earliest of spring plants.

Pumpkins and squash contain from 1 to 5 per cent. of starch, about 1 per cent. of sugar, and less than 1 per cent. each of nitrogenous matter, fat, and ash.

Thoroughly ripe melons are beneficial in season on account of their action upon the kidneys. They should never be eaten, however, unless they are thoroughly ripe and of good quality.

STARCHES.

The food value of the starches is small, but they are easy of digestion, and are serviceable in preparing dishes for the sick. Besides, when mixed with nitrogenous and fatty substances, they are largely used in making puddings. In this way, stale bread and other remnants from the table may be converted into palatable dishes.

Sago and arrow-root are obtained from various palms. The former appears in small granular masses, which, when dry, are so hard that they can scarcely be crushed by the teeth; but they readily absorb water, and soften.

Arrow-root, when pure, is found in perfectly white lumps, which may readily be crushed between the fingers. When boiled with water and constantly stirred, no foam should form on the surface. The presence of a foam indicates that the arrow-root has been adulterated with flour.

Tapioca, obtained from various tropical plants, and corn and potato starches, are also used in puddings.

SUGARS.

Sugar is a name now given to a class of substances which vary among themselves to some extent both in physical and chemical properties, though ordinarily the term "sugar" is supposed to refer to that obtained from the sugar-cane and sugar beet. Practically there are now in the trade three kinds of sugar,—cane sugar (obtained from the cane and beet), glucose or grape sugar (obtained by the action of dilute acids on starch), and "mixed sugars," or "new-process sugars" (consisting of cane and grape sugar mixed in various proportions). Cane sugar is here referred to, unless some other is specifically mentioned.

Sugar is used for modifying the taste of other foods, and for the manufacture of confectionery and syrups. By improving the taste, sugar, when added in proper amounts, aids the digestion of other substances, and furnishes a certain amount of nutriment in itself.

Good, crystalline, white sugar contains less than one half of 1 per

cent. of water, and not more than this amount of ash. Yellow sugar may contain as much as 2 per cent. of water.

Grape sugar may contain from 10 to 25 per cent. of water, and from one half to 2 per cent. of ash.

Much has been said about the adulteration of sugar with glucose. That this has been practised to a considerable extent is shown by numerous analyses. Indeed, "mixed sugars" are sold by wholesale dealers, and too frequently the retail grocery-man sells these to his customers as straight cane sugars.

Experts can recognize these sugars by the way they "handle." "They are apt to cake and harden, and stick to the scoop and sides of the barrel. In the white, granulated sugars, the mixture of the white lumps of glucose with the crystalline cane sugar can be readily seen ; but in the brown sugars it is difficult to detect the fraud by the appearance of the sugar. When a mixed sugar is shaken with cold water, the white lumps of the glucose will remain undissolved for some time after all the cane-sugar has passed into solution."

Glucose, when made with care,—and it must be so made when it is used to adulterate sugar,—is not harmful to health. The fraud is a pecuniary one, as glucose costs usually less than two cents per pound ; but when mixed with sugar, it is sold for six cents and more per pound. The sweetening properties of glucose are not so great as those of cane sugar, and consequently, in the preparation of foods, much more of the mixed sugar is required than would be necessary with cane sugar.

Confectionery. The various candies are made from sugar, or sugar and starch, with or without coloring matters. Twenty-seven samples were examined under the writer's direction, in order to ascertain whether or not they contained any poisonous substance. One sample consisted wholly of starch, terra alba, and an analine color, without any sugar. The use of terra alba (white earth, or clay) in any considerable amount would be harmful on account of its indigestibility. Only two samples contained ultra marine as a coloring agent. This would also be harmful if used in large quantity. The other samples were all free from any suspicious ingredient. The coloring agent most frequently used is analine. Grape sugar is extensively employed in the manufacture of confectionery.

Honey. This is frequently adulterated with glucose, which may be added directly to strained honey, or may be fed to the bees, and by them deposited in the comb. Unadulterated honey varies in flavor according to the plant from which it is gathered. White clover and buckwheat honeys are much prized in this country. The fact that honey sometimes produces unpleasant symptoms is probably due to bees feeding upon poisonous flowers, though the susceptibility of the individual partaking of it probably plays an important part. Pollen grains are often mixed with honey, and the unpleasant effects upon the system may be, in part at least, due to these.

Molasses and Syrups. These are solutions of sugar, and they are now frequently made by a mixture of cane syrup and glucose. Indeed, many

prefer a syrup containing glucose: it is not so sweet as a pure cane-sugar molasses. However, the former should be much cheaper than the latter. As in the case of sugar, the fraud here practised is a pecuniary one rather than one detrimental to health.

FRUITS.

Fruits abound in tropical and temperate climates, and furnish a great variety of flavors, which are useful in themselves and for the purpose of rendering other foods more enjoyable. The real food value of fruits, judged by their chemical composition, is small, but when thoroughly ripe and well preserved, they act beneficially upon the system, improving the appetite, and maintaining a healthy condition of the various vital organs. Probably no fruit is necessary to life, and fruits may be regarded as luxuries; but man's instinct and cravings prompt him to obtain them often, even when their cost is considerable. Undoubtedly they are most highly prized by the inhabitants of warm countries, where foods which produce but little heat are most desirable. The most enjoyable part of fruits is their juice, which consists principally of watery solutions of sugar and acids. The amount of sugar in fruits varies from 1 to 18 per cent. The cellular parts are not easily digested; and those fruits are prized most highly which have the greatest quantity of juice with the smallest proportion of cell structure.

The majority of fruits may be eaten either raw or cooked, and those which cannot be preserved in their natural condition may be dried. Therefore, in one or the other form, they may be enjoyed at any season of the year, and may be served with other foods.

The volatile ethers, upon which the flavor of many fruits depends, have been made artificially by the chemist, and, under the name of essences, are largely used in cooking.

It is wholly unnecessary even to mention the various fruits in use, as all are sufficiently acquainted with their general properties and composition. Suffice it to say, that thoroughly ripe fruit, taken in moderation, can have no deleterious effect upon the system. However, care should be exercised in using fruits imported from countries in which an infectious disease, such as cholera, prevails. Such fruit should at least be thoroughly washed, or stripped of its covering, and, if suitable for such purpose, should be cooked.

Canned Fruits. In buying canned fruits, it should be observed that the ends of the cans are concave. If convex, there has probably been some decomposition of the contents with the evolution of gas. Cases of severe poisoning have followed the eating of partially decomposed canned fruits. Moreover, if the cans appear old and battered, thus giving evidence of having been used twice or oftener for the purpose of preserving fruit, they should be rejected, since the contents of such cans are liable to contain small amounts of tin or other metal, which may prove poisonous. Much having been said about the use of salicylic acid, in canned fruits,

as a preservative agent, the writer requested one of his students to examine samples from all the more prominent firms engaged in the preparation of canned foods, for this adulteration. In no case was the acid found. Frequently agents pass through the country, offering to sell preparations or recipes for the sure preservation of fruit. The active ingredient of all these formulas is salicylic acid or some form of sulphurous acid. The use of such preservatives is unnecessary. Moreover, they injure the taste of the fruit, and are liable to prove deleterious to the health of the consumer.

Prof. Sharpless states that "apple-sauce" is frequently pumpkin boiled with cider; that the raspberry-jam offered for sale is often sour; and that strawberry-jam is frequently made from the refuse strawberries of the market.

NUTS.

Judging solely by chemical composition, nuts should be classed among the most nutritious foods. The following figures give the percentage composition of sweet almonds, walnuts, and hazelnuts, from numerous analyses collected by König:

	Water.	Proteids.	Fat.	Starch and Sugar.	Cellulose.	Ash.
Almonds, ...	5.39	24.18	53.68	7.23	6.56	2.96
Walnuts, ...	4.68	16.37	62.86	7.89	6.17	2.03
Hazelnuts, ...	3.77	15.62	66.47	9.03	3.28	1.83

But nuts are not easily digested, and, with the exception of cocoa-nuts, do not form an important part of the food of any people. They may be regarded simply as luxuries, so far as their use in this country is concerned. Crushed acorns are used to some extent in the adulteration of ground coffee.

VEGETABLE OILS.

On account of our abundant supply of animal fats, the vegetable oils are not extensively used as foods in this country. The one best known is olive oil, which is used as a dressing for other foods. Olive oil, however, has been largely adulterated, or supplanted, by cotton-seed oil, large quantities of which are sold as olive oil.

CONDIMENTS.

Condiments are substances whose employment in cooking is for the sole purpose of seasoning foods. However, at least one member of this class,—common salt,—is essential to healthy existence. Condiments improve the taste of foods, sharpen the appetite, and improve digestion. While much benefit arises from this use in small amounts, when taken in excess they may prove highly detrimental to health.

It is stated that certain tribes in the interior of Africa exchange gold for salt, ounce for ounce. This illustrates the great need of this substance felt by the animal system. We know that wild animals some-

times travel hundreds of miles in search of salt-licks. Experiments have been made, in which two oxen were placed under exactly the same conditions, and furnished with the same food, save that salt was denied one, and given to the other. The one deprived of salt did not thrive as did the other.

The purity of salt is judged of by its whiteness, fineness, dryness, and perfect solubility in water. The coarser kinds of salt contain compounds of lime and magnesium, are often dark in color, and absorb moisture from the atmosphere.

Vinegar is an acid fluid, which may be produced by the fermentation of any solution containing sugar. Cider and wine vinegars are most highly prized, though the following varieties are now sold in this country:

(1) Cider vinegar, from apples and pears.

(2) Wine vinegar, from grape juice and inferior wines.

(3) Malt vinegar, from barley.

(4) Beer vinegar, from sour ale or beer.

(5) Glucose vinegar, from grape sugar.

(6) Crab vinegar, from crab-apples.

(7) Artificial vinegar, made with dilute solutions of the mineral acids, especially sulphuric acid.

The acidity of vinegar is nominally due to acetic acid. Sulphuric acid is sometimes added to increase the acidity. The British law allows this adulteration to the extent of one tenth of one per cent.; but if the vinegar be properly prepared, such an addition is not necessary; and if any addition be allowed, the amount is likely to exceed that given above. Burnt sugar is sometimes added to vinegar to give it color.

The per cent. of acetic acid should be at least 3. Of five samples recently examined, the smallest per cent. was 3.2, and the greatest, 6.7. Only minute traces of mineral acids were found in three of these samples, while the other two were wholly free from such adulteration.

Table mustards are frequently diluted with tumeric, flour, or yellow lakes. Pepper is sometimes mixed with flour, bread, or starch. Spices are frequently adulterated with flour, starch, bread, and ground pea-nut shells. Cloves may contain arrow-root. In order to obtain spices pure, they should be purchased unground.

TEA.

Tea is the most extensively used and the least harmful of all beverages. Upon most persons it produces agreeable sensations; "it cheers, but does not inebriate." It relieves, to a certain extent at least, the feeling of bodily weariness, quickens the pulse, and deepens the respiration. Upon the nervous system it acts as a stimulant, and the excitation is not, as in the case of alcoholic drinks, followed by depression. Considerable discussion has been carried on over the question whether or not its use increases waste of tissue. This may now be considered as settled in the affirmative. Dr. E. Smith and others have repeatedly shown that the

amount of waste matter in the air exhaled from the lungs is markedly increased. Tea, then, acts as a food principally by hastening the oxidation or burning of other substances in the body.

It creates a blast which burns up the half charred *débris* of the system, and from the burning or oxidation we receive increased energy. From what has been said, it will be evident that the only time when tea should be used is late in the day, after the heaviest meals have been taken. For the weak and debilitated it is not suitable, or should be used very sparingly. Its tendency to produce sleeplessness may also restrict its use.

So far as its chemical composition is concerned, tea contains but little of nutritive value. The high place of tea among foods is solely due to its effect upon the nervous system.

In the market there are two kinds of tea,—green and black. Until recently it was supposed that these were products of different species, or at least of varieties, of the tea plant; but it is now known that the two kinds arise from different methods of curing the leaves. In preparing green tea, the leaves are dried immediately; while in the other, the leaves are thrown into heaps, and a certain degree of fermentation or decomposition is allowed to take place before the drying is perfected.

The chief constituents of tea are its active principle called theine, which is identical with the active principle of coffee, a volatile oil, tannic acid, and a small amount of ordinary food substances.

Theine forms from 2 to 3 per cent. of tea. In making tea, as is ordinarily done, the greater part of the theine is dissolved out of the leaves,—tea yielding its active principle to water more readily than coffee. From equal weights, three times as much theine is obtained from tea as from coffee. According to the investigations of Mr. Fellows, 224 five-ounce cups of tea beverage are made from one pound of tea, and 45 eight-ounce cups from a pound of coffee. This makes the cost of an ordinary cup of tea, when the leaf sells at 75 cents per pound, about one third of a cent; and of a cup of coffee, when the berry sells at 27 cents per pound, about three fifths of a cent. In this estimation the sugar and milk added to these beverages are not considered.

The volatile oil of tea is the special stimulant, and the market value of a tea depends more upon this than any other constituent. The amount and quality of this substance present are judged by the odor as well as by the taste of the hot beverage. Large tea houses have experts who are called "tea-tasters," and whose duties consist of deciding as to the value of different samples by the odor and taste. By virtue of the volatile oil, tea increases the flow of perspiration, and thus, although taken hot, may act as a cooling agent. The volatile oil is more abundant in green than in black tea.

Tannin is also more abundant in green than in black tea. The object in making tea should be to dissolve as little of the tannin as possible, and at the same time extract as much as possible of the theine and volatile oil. To accomplish this, tea should be steeped five or ten minutes, by no means longer than ten minutes; but the water should be kept warm after

that until the beverage is drawn for drinking. Mr. Fellows found the amount of tannin extracted from the best Japan tea, after steeping for five minutes, to be 0.10 per cent.; after ten minutes, 0.98 per cent.; after thirty minutes, 3.09 per cent. It is to the tannin that the astringent properties of tea are due, and when tea has been boiled, it is so astringent that it is well-nigh unfit for use, and indeed may cause derangements of the digestive organs.

Tea contains small amounts of albuminous and starchy substances, but, as has been stated, these are present in such small amounts that they are not worthy of consideration.

Tea is subject to the following adulterations, which, fortunately, are not largely used at present:

(1) "Spent" leaves, those which have been once used for making tea, are dried, and mixed with fresh leaves. This adulteration is not practised extensively in this country.

(2) The poorer varieties are mixed with the better, and the whole sold as of first quality.

(3) Green tea is sometime tinted with indigo and gypsum Prussian blue is said also to be used, but the writer has failed to detect it after examining many samples. Black tea is also tinted with graphite. This is not used in large amounts, and, as used, is not detrimental to health, but is a pecuniary fraud.

(4) Other leaves, notably those of the willow, elder, and beech, are added to the tea leaves. None of these are exactly like the tea leaf, and the adulteration may be detected by close inspection, even without a microscope. The border of the tea leaf is serrated nearly, but not quite, to the stalk. The primary veins run from the midrib nearly to the border, and turn in so that there is a distinct space left between their terminations and the border.

Tea dust, which consists of broken leaves and sweepings of tea storage houses, is a legitimate article of commerce, yielding an average of 1.27 per cent. of theine.

COFFEE.

It is unnecessary to go into detail concerning coffee, since it resembles tea in so many of its properties. The active principle of coffee, called caffeine, is identical in chemical composition and physiological effects with theine of tea. The per cent. of this substance in the raw coffee berry is about one, and this is not given up so readily to water as that in tea.

There is no volatile oil, corresponding to that of tea, in raw coffee; but one or more such oils are generated by roasting. The physiological action is not the same, however, as that of tea. It is not so stimulating, nor does it increase the perspiration to so great an extent.

Tannin is present in a much smaller amount than in tea, and for this reason the steeping of coffee may be carried on longer than ten minutes.

The unground coffee cannot be adulterated to any extent; but the ground coffee put in packages and boxes is almost universally adulterated.

Often it contains no coffee at all. A student of the writer examined all the specimens that could be obtained in the market. The first, known as Java coffee, put up by the "Centennial Coffee Company," of New York, contained, besides some coffee, chickory, pease, wheat, acorns, and corn. The second, "Gillies Gold Medal Java," contained very little coffee, being composed principally of wheat, much of it unground chickory, corn, and pease. The remaining samples were ground coffee, sold in bulk, and in every case adulterated.

CHOCOLATE.

Chocolate is prepared from the ground seeds of the fruit of the cocoa palm. Cocoa nibs consist of these seeds, which are about the size of almonds, roughly broken, while chocolate contains a substance,—theobromine,—very similar, but not identical with theine or caffeine ; its other constituents give it a very different position in the class of foods. The cocoa seeds contain from 45 to 49 per cent. of fat, and from 14 to 18 per cent. of nitrogenous matter. It will be seen from this that these seeds may be classed among the most nutritious foods. Chocolate always contains sugar, which has been mixed with the ground seeds.

Chocolate does not stimulate the nervous system to anything like the extent that tea and coffee do ; but for travellers and others who cannot obtain milk, chocolate may be used instead of that, the most nutritious of liquid food.

Chocolate is often adulterated by the addition of too much sugar, or with starch.

THE SANITARY CONDITIONS AND NECESSITIES OF SCHOOL-HOUSES AND SCHOOL-LIFE.

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SCHOOL HYGIENE.

INTRODUCTORY.

Two men should be mentioned at the head of an essay of this sort, as deserving to represent the beginning of the "movement" in school hygiene. They are Cohn of Breslau, whose examinations of the eyes of school-children made a very powerful impression on the public mind some sixteen years ago, and Virchow, whose official report to the Prussian minister of education (published in 1869), is the most prominent document that can be referred to as leading the way in reform.

It is not intended in this essay to quote largely from German authorities. The mere statement of principles and facts must suffice in so wide and manifold a subject as the present.

It should be noted that Virchow makes use of the expression "school-diseases." He is probably entitled to the credit of inventing the word. In the list which he gives there is one affection which we need not dwell upon, namely, nose-bleed. In regard to another,—tubercular consumption,—there is perhaps a deficiency of evidence as to its causation in schools in America, though there can be no reasonable doubt that it is so caused, and the writer has the highest American authority for saying so.

Deformity of the spine (lateral curvature) is probably not so common by a good deal in America as Guillaume represents it in Switzerland. We lack decided evidence ; but it is spoken of under the proper heads in this essay.

It remains to note the division of the subject which has been followed, viz. :

1. Site of the School-House.
2. Plan and Arrangement of the Building.
3. Ventilation and Heating.
4. Sewerage.
5. Hygiene of the Eye.
6. School-Desks and Gymnastics.
7. Affections of the Nervous System.
8. Contagious Disease.
9. Sanitary Supervision.

I. SITE.

In choosing the site for a school-building, we should take into account a number of things which might be overlooked in the case of an ordinary building. Dampness and malaria are of course fatal to a site for any purpose. For schools we must plan to have abundant light (much more than will suffice for dwellings and shops), and to have the sun's direct

rays enter each room at some time of the day. The business of the school requires the absence of noise,—a point which may be overlooked in business edifices; and the social character of the neighborhood, and its moral nuisances, are also to be considered.

Dampness. Without going much into details, the use of some method of drainage and of some shield against incoming water is suggested, as likely to be needed in many places. The cellar, as hygienists know, ought to be carefully guarded from contamination of soil and air, and should at all times be dry. Grading will suffice to keep off most of the surface water. Underground water may be provided for by a ditch, dug outside of the foundation and reaching deeper than the cellar floor, and either laid with drain tile, or filled to the depth of a foot with loose stones, after which earth is thrown in. A similar trench may be cut in the floor. All such drains are to be led to a proper place for discharge. The floor may be made damp-proof, according to Col. Waring's suggestion, by six inches of well rammed clay, or by asphalt between two layers of cement; the foundation walls may be protected by a coating of asphalt outside. A damp-proof course of asphalt in the walls above the ground is useful in preventing moisture from rising.

Small country schools, if without a cellar, should at least have an air-space underneath the floor, with a few openings in the underpinning, to give ventilation to the space.

River bottoms, places where mist is often seen, and the neighborhood of ponds, are undesirable places for building. No business is more interfered with by noise than that of school. The neighborhood of large factories, saw-mills, foundries, railway stations, engine-houses, or police stations, is therefore to be avoided. There need be no excuse for placing a school-house near any such of the latter as are under public control, or for utilizing a town lot by putting engine-houses, school-houses, and a police station, in close neighborhood. Regard ought to be had for the probable growth of a city, and avenues likely to become main lines of travel should be avoided. These things are mentioned because they are sometimes strangely disregarded. In large cities it is next to impossible to procure sites which fully satisfy the demand of hygiene in respect to the supply of light. Corner lots are enormously expensive, besides being noisy. The *Sanitary Engineer* prize designs for public schools, published in 1880, are instructive as showing that in the opinion of the prize committee,—

"The most essential thing in a public school is sufficient light. The conditions imposed in this competition make it impossible to secure this light without either overcrowding of class-rooms, or an unsatisfactory arrangement of corridors, stairs, etc."

"Upon so restricted a site as that contemplated[1], light can best be secured by making the building very high, higher than for other reasons is desirable.

[1] "A lot fronting north, of 100 feet front and 100 deep, and enclosed by buildings on adjoining lots at the sides and rear, of average city height, say four stories." (Advertisement.)

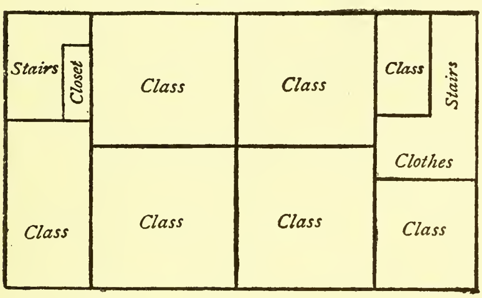
"It should be distinctly understood that the committee do not recommend the plans to which they have given awards as being the best designs for a school building, but only as the best plans for a school building to be built in a huge box, lacking one side and without a top, the sides of which box are about sixty feet high, which seem to be the conditions under which school buildings have been erected in New York, and in which from 1,500 to 2,500 children have been crowded."—(*San. Engineer*, March 1, 1880.)

The evil complained of is a general one. New York is not the only city where fine new school buildings are erected, with a pleasant outlook all around, only to have four-story houses placed on both sides, within a dozen feet of their windows, in the course of a year or two. This is one of the worst failings of city schools.

II. PLAN AND ARRANGEMENT.

Many of our oldest school buildings are extremely faulty. In fact, we have seen two reformations in school architecture, one dating from the publication of Henry Barnard's work, in 1839, while the other is now taking place. The progress made within a few years past has been as great as at any other period, and types of edifices, which were unchallenged models of excellence fifteen years ago, are now superseded.

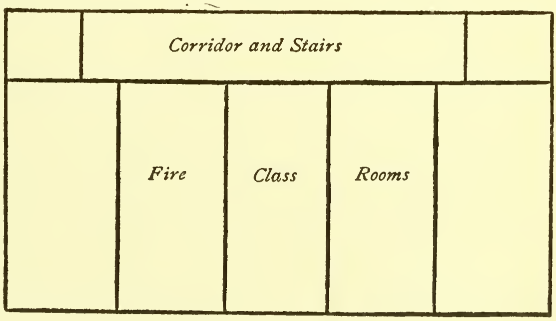
Fig. 1.



Plan of School-house illustrating excessive compactness.

In schools containing several rooms, one of the commonest faults used to be the parsimony of space, which cut down the room for entries to a minimum, and packed class-room behind class-room without breathing space. The effect of this was greatly to restrict natural ventilation. Glass sliding doors were very popular: it may be feared that they still are in some places. Spiral stairs were admired. Architectural features, such as colonnades and heavy Greek entablatures, are still seen on some older buildings, the former serving to cut off a certain part of the light, the latter taking

Fig. 2.



Plan—Same fault.

up space in the wall which ought to be devoted to windows. Excessive height is a fault which is only just beginning to be remedied. It arises partly from a false taste in architectuie, partly from the expensiveness of land in cities.

An instance of the excessively compact style of building is given in the illustrations (Figs. 1 and 2), which are taken from the Report of the New York State Board of Health for 1881; also in Fig. 3.

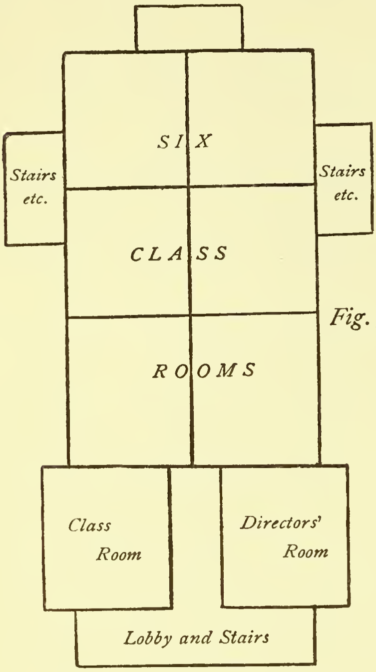


Fig. 3.

Plan of School. Philadelphia.

Glass sliding doors are supposed to assist in lighting rooms which are faultily lighted in other respects. They are far less effectual than is thought. A person standing in the inner room looks out through the glass doors upon well lighted rooms, and thinks the light he sees is entering the room where he stands—a false impression, which should be corrected by looking the other way. Light thus transmitted is nearly horizontal in direction, and has very little effect in brightening the page of a a book lying on a desk. Glass also reflects some light, and absorbs some. In short, light thus obtained is not good light for the purposes of study. The rooms in Fig. 3 have glass partitions.

Another common fault in plan is to have one of the rooms of such dimensions that it is impossible to light it advantageously. Such very large rooms form an essential part of many high schools, even of modern construction; they are used as rooms of assembly, and also as the general study rooms, each pupil having a desk there, and only leaving it as occasion offers to go to small recitation-rooms. Such rooms are usually lighted from the right and left sides. The width between the windows is sometimes as great as seventy feet. The great distance of the windows from the central parts of the room is a marked disadvantage. Twenty or twenty-five feet is as far as a desk ought to be from the window.

Associated with this fault,—or independently,—may be found a deficiency in the size of recitation-rooms. It seems to be supposed that these places do not require as much space as ordinary class-rooms, the fact being, that they are apt to be in use about all the time, and therefore are in no way to be excepted from strict requirements. When looking for instances of bad ventilation and overcrowding, one should not omit to visit these rooms. The allowance of cubic space for each scholar will be mentioned later.

A type still in vogue, which has some decided merits, may be called the four-square plan. It contains, on each floor, four rooms and a corridor: the corridor runs from front to rear, and the rooms are in pairs to right and left. There is a staircase in front and rear. Each room is lighted from one side and the rear of the scholars: each room is a corner room. The type which is likely to supersede this one is based on the wish to give more light and ventilation in the corridors. Both are illustrated (Figs. 4 and 5). It would be rash, however, to point to any one plan as likely to have exclusive success.

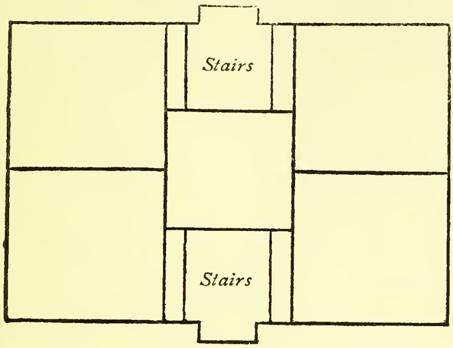


Fig. 4.

The objection to spiral stairs is, that the tread is very narrow on the side next the wall, and a careless person easily gets a severe fall. The tread should never be wedge-shaped. It is a good plan to break up a flight of stairs by placing a landing half-way, with a full turn. Both stairs and corridors must be well lighted. The steps must be easy to ascend.

It is desirable to build stairways as nearly fire-proof as possible. They may be enclosed in brick walls, so that fire from the main edifice will reach them with difficulty. One staircase should be placed at each end of the building, so that no room need be cut off by smoke or flame at the

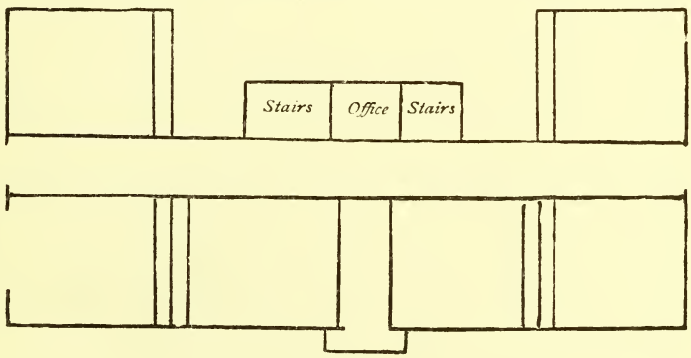


Fig. 5.

outbreak of fire: it will be easy to go a step further, and place them outside, or partly outside, of the building, for more complete isolation. If the framework is of iron, the treads may be of hard wood, which makes them for all practical puposes fire-proof.

These precautions are among the first to be taken against fire—we might say against panic, for the danger to life from fire, in a school where children are orderly, is scarcely to be thought of. A thousand children can be got out of a large school within two minutes of an alarm

from the principal. They say it can be done in less time; it depends, however, on having the children exercised in a special "fire-drill," the sole object of which is to pass them out as quickly as possible. In the best schools this drill is given *without warning* once a month.

Further precautions against fire may be taken: they ought not to be limited, however, to prevention of combustion, but should include some means for carrying off smoke, which is so apt to cause panic. To this end, it is proposed, by the chief engineer of one of our large cities, to have a large valve, easily opened, at the roof, so as to draw out great quantities of air or smoke. There may be also extra flues, built in the partition walls, communicating with such floor spaces or wainscot spaces as may be supposed likely to be the seat of fire. The flues will not afford a supply of air to the flame, but will only carry off the smoke and gases instead of letting them come through the floors. The writer does not express an opinion upon these suggestions, but they rest on good authority. Fire-proofing beneath the floors with layers of plaster is certainly to be recommended; also, the practice of bringing the floors close up to the walls, thus cutting off the connection between story and story, which is so often the means of transmitting a fire with surprising rapidity to the upper stories. Perhaps the chief benefit of all these precautions, as regards safety of person, lies in the feeling of security against sudden conflagration, which will give confidence in the moment of alarm to some teachers who might otherwise be overpowered by sudden dread.

There are some buildings in most cities which were never meant for schools, but which are crowded with poor children, whose danger would be imminent in case of fire. A so-called fire-escape, placed on one of these wooden traps, affords a possible means of safety, but, for the most part, a good staircase in a well built school-house is the best "fire-escape."

The passages to be passed through by the scholars in reaching the door should be wide; the outer doors should swing towards the street. There should be two doors at least,—one for each staircase.

The competition for prizes for model school-house plans, which took place in 1880 in New York, has already been mentioned. The conditions upon which the committee of award based their judgment deserve to be quoted. In their opinion "a public school building to be erected in a large and densely populated city, should possess the following qualifications, viz.,—

"I. At least two adjoining sides of the building should be freely exposed to light and air, for which purpose they should not be less than sixty feet distant from any opposite building.

"II. Not more than three of the floors should be occupied for class-rooms.

"III. In each class-room not less than fifteen square feet of floor area should be allotted to each pupil.

"IV. In each class-room the window space should not be less than one fourth of the floor space, and the distance of the desk most remote from the window should not be more than one and one half times the height of the top of the window from the floor.

"V. The height of a class-room should never exceed fourteen feet.

"VI. The provisions for ventilation should be such as to provide for each person in a class-room not less than thirty cubic feet of fresh air per minute, which amount must be introduced and thoroughly distributed without creating unpleasant draughts, or causing any two parts of the room to differ in temperature more than 2° F., or the maximum temperature to exceed 70° F. This means that for a class-room to contain fifty-six pupils, twenty-eight cubic feet of air per second should be continuously furnished, distributed, and removed during school hours.

"The velocity of the incoming air should not exceed two feet per second at any point where it is liable to strike on the person.

"VII. The heating of the fresh air should be effected either by hot water or by low pressure steam.

"VIII. The fresh air should be introduced near the windows; the foul air should be removed by flues in the opposite wall.

"IX. Water-closet accommodations for the pupils should be provided on each floor.

"X. The building should not occupy more than half the lot."

The only comments by way of exception that need to be made upon this are, that in VI it seems hardly possible to expect a temperature varying only two degrees all over a room, if the difference between ceiling and floor is intended to be included; and further, that the method of introducing fresh warm air, etc., given in VIII, is not the only desirable one, as will be shown under "Ventilation" later in this essay. In No. IV the size demanded for windows is based on the requirements of city architecture.

In other respects the recommendations deserve unqualified approval, as embodying the chief sanitary requirements in a city school-house.

Height of School Buildings. Not merely on account of danger from fire, but for reasons affecting the health of pupils, excessive height has been, within a few years past, much spoken against. It seems desirable, on the whole, to limit the height to three stories, of which the first two should contain most of the school-rooms. The reasons for this restriction are such as apply chiefly to girls of the age of fourteen and upwards; more especially, to young ladies in normal schools and seminaries. Not to enlarge upon this point here, it is well to notice the unwillingness of such girls, if placed in the upper story, to descend to the play-room or yard for recess. The climbing of many flights is an evil which may come about in another way, viz., when scholars study in one story and descend to another for each recitation. In such cases the need of consulting teachers before building is evident. The plan of the house should be made to depend on the plan of study, and architects can seldom fail to gather some useful information from those conversant with the uses to which their work is to be put.

A point to note in conclusion is the smallness of the yards allotted for the children's play in American cities as compared with what is found in Europe.

III. VENTILATION AND HEATING.

This is one of the chief topics, and one of the most difficult, connected with School Hygiene.

It is comparatively easy to build a convenient and spacious house: the requirements are well known, the cost is tolerably definite, for a given place and time. The problem of merely heating a given space is also one of moderate difficulty. But ventilation is a matter about which a general opinion is hardly yet formed, and the cost of which is very vaguely known. People in general are not yet agreed as to what constitutes good ventilation—how much fresh air per hour is required.

Between a barely tolerable system, eked out by opening windows, and a system which really furnishes a supply of from thirty to sixty cubic feet of fresh warm air per head and minute, there are many shades of difference. Few have a mastery of the somewhat complicated questions involved; very few have seen successful and logical experiments made; and many are called on to act as judges—to act upon an opinion which they cannot have formed.

Amount of Fresh Air and Cubic Space Required. It is unfortunate that authorities differ so widely on these points. The New York Metropolitan School Board sets the minimum allowance of space per head at from 70 to 100 cubic feet, according to age. Fortunately, this does not represent the general practice in that city,—though, to the eye, the appearance of many infant classes suggests the idea of sardines in a box. Most authorities would wish to double these figures, at least.

According to recent inquiries in Boston, there is no corresponding law or regulation; but it is customary to build rooms for fifty-six pupils, with an allowance usually ranging from 160 to 220 cubic feet per head. Prof. Kedzie, of Michigan, claims 300 cubic feet; A. C. Martin, 220; various German states, from 120 to 284. The Conseil Supérieur d'Hygiène Publique, in a recent report to the Belgian Ministry of the Interior, recommends a minimum of 6¾ cubic metres per head, or about 240 cubic feet, a space which requires the unusual height of 4½ metres, or about 14 ft. 10 in. The high position of the sanitary service, especially as regards schools, in Belgium, lends weight to their recommendation.

It is the writer's belief that it is desirable to limit the size of classes to forty (40) pupils. Experts in education recognize the gain that accrues to the individual scholar from such limitation. If we base the calculation on this figure, we have more liberty of choice between large and small rooms in making our plan for a building. The advantage of space is twofold;—it enables us to introduce large volumes of air, fresh and warm, without danger of draughts; and it gives more value to the practice of airing-out the room by windows at recess times, since a large roomful of fresh air lasts longer than a small one. But there is such a thing as too much space, entailing difficulties in regard to discipline and teaching, and making it hard to secure good light. For example, a class of fifty-six, with an allowance of 250 cubic feet each, requires a room of

the capacity of 14,000 cubic feet, or 27 feet wide, 37 long, and 14 high, dimensions which can hardly be profitably exceeded, if indeed they are not too great already.

As regards the amount of fresh air to be introduced hourly, it is desirable to found our ideal upon the basis of Parkes & DeChaumont's views, which represent the best authority. By depending upon the testimony of their senses as to whether rooms were "close" or "fresh," these authorities reached the conclusion that it is not desirable to allow the amount of carbonic acid in air to exceed the proportion of 6 parts in 10,000. Any higher proportion seemed to be attended with perceptible closeness.

Now, assume that fresh air from out of doors contains 3½ parts in 10,000, which is a trifle below the usual rate. A room of the capacity of 10,000 cubic feet, freshly filled with this air, and tenanted by one man, would receive from his lungs an addition of 2½ cubic feet of carbonic acid in 4⅙ hours, raising the total to 6 cubic feet. If, then, 10,000 cubic feet will last 4⅙ hours, the supply for one hour should be 2,400 cubic feet, or for one minute, 40 cubic feet.

The usual assumption is, that "fresh" air contains 4 parts, not 3½, in 10,000. If so, the hourly requirement is about 3,000 cubic feet, or 50 per minute. Billings increases this to 60. If an average school-room of the better class contains an allowance per scholar of 200 cubic feet of space, there would be a necessity for renewing the air completely every four minutes, or fifteen times in an hour. This requirement, however, is intended to apply to rooms used day and night, such as barracks. For school-rooms, the amount may be less, owing to the opportunities for frequent airing, and the total disuse out of school hours. The writer agrees with Dr. Billings in the belief that, *for schools*, the allowance of *from 25 to 30 cubic feet per minute and head* will answer all needful purposes, if supplemented by occasional airing-out during and after school.

It is evident that if air is to be introduced so rapidly, there should be a liberal allowance of room, in order that the incoming air may not be felt as a draught. The outgoing air, by the way, is rarely felt; but a very vigorous draught may be appreciable two feet from the register.

Do children require a smaller allowance than adults? or, Do small children require less than large ones?

One answer, in the affirmative, is derived from the estimates of the amount of CO_2 exhaled at different ages. Breiting gives it, for girls aged seven or eight years, at a little over 10 litres per hour; at the age of eight or nine, 12 litres. If engaged in singing, it is 16.7 for the latter age. Boys aged twelve or thirteen expire 13 litres; during singing the amount rises to 17. Scharling gives, for the age of ten years, close upon 10 litres; for a boy of sixteen, 17.4; for a young woman of seventeen, 12.9; for adults, a little more. Pettenkofer & Voit give 16.8 for a weak man, and 22.6 for a strong man.

It would appear, then, that there is a decided difference to be allowed

for. Primary pupils expire less CO_2 than high school pupils, in the ratio of 2 to 3; or perhaps the difference is still greater. If a room ought to contain the cubic space of 250 feet per head for larger scholars, it need contain only 180 for the same number of small scholars. In other words, forty large and sixty small scholars can be accommodated in an equal space.

This estimate, however, is admissible only on the supposition that the ventilation is efficient. In case of defect, or apprehended defect (and this covers a wide ground), the young children should have equal room with the older ones, on the ground of their comparative inability to cope with the deleterious effects of bad air; also, because in contracted quarters the danger of draughts from windows is greater. It has been said that children need a proportionately large allowance, "because metamorphosis of tissue goes on more rapidly in them." We have two means of estimating the amount of tissue-change,—the quantity of CO_2 exhaled, and the quantity of *food consumed*. On the whole, the latter item is sufficient for the argument, and may be believed to represent the amount of change of tissue very well. It is quite evident that, though boys of fifteen may consume as much food as men, children of eight do not. A supply of air, then, which would be liberal for a large boy, would be more than liberal for a small child. The degree of allowance to be made is a point upon which distinguished authorities differ. DeChaumont would place three times as many children of four or five years in a given room as youths of fifteen or sixteen, while Billings would allow very nearly the same amount for children of all ages.

Dimensions of Ventilating Apparatus. Let us suppose the case of a school-house to be planned for thorough ventilation. It is assumed that all the air to be extracted is to be carried by flues through the roof. We will first consider the flues for extraction. The resistance offered by friction is of great importance, and should lead us to make the flues of liberal size, as straight as possible, and smooth internally. A flue of less than eight inches internal diameter is not worth much. The inside should be finished in smooth plaster, or, better, with sheet metal; never with rough brick unless very large. Angles check momentum very greatly; so do horizontal passages.

Suppose a single room to be ventilated by a single brick flue, straight and well made; and suppose the only force to produce a current is the warmth of the air leaving the room at 68°. It is probable that if the flue is of moderate height, with no fire, the upward draught will seldom exceed the rate of two feet per second. An average of two would be a liberal allowance. If there are fifty-six pupils, the chimney is expected to discharge 28 cubic feet per second, and in order to do this, it must be at least 14 feet in sectional area, or about 4 by $3\frac{1}{2}$ feet inside measure. The register opening to this flue should be at least as large. (The reader may try to form an idea of this by measuring the dimensions on the wall.)

Not to speak of the register, such large flues cannot be introduced into

a building already finished, and can hardly be thought of in a new plan. There is, indeed, no necessity of so large a shaft if we provide a somewhat different arrangement. If convenient, we can cause the furnace-smoke to be carried up this flue in a cast-iron pipe, thus increasing the heat, and possibly doubling the velocity. In large buildings, moreover, the whole system must be centralized, and this is done in two ways,—first, by conducting the foul air from each room by long tubes to a central heated chimney; and second, by grouping rooms so that they discharge their foul air at once into the chimney, without intervening "ducts." The latter is the plan of the Bridgeport, Conn., high school, to be described presently.

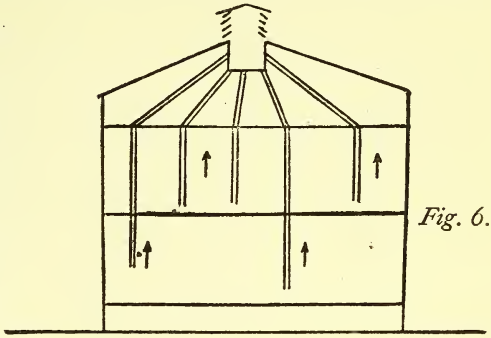


Fig. 6.

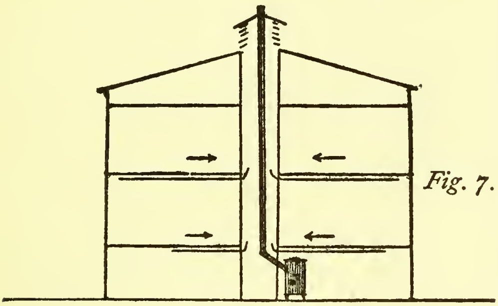


Fig. 7.

Three illustrations (Figs. 6, 7, and 8) show how the first plan may be carried out. It is to be observed that they all imply the expenditure of extra heat to force a draught; also that in No. 6 the heat is applied in a chamber in the attic (which may be of wood lined with sheet metal), while in the others it is imparted by the smoke-flue of the furnace. The most economical plan of the three is stated by Planat to be the last; the least economical, the first. The Bridgeport school plan is illustrated in the next plan (Fig. 9). It is ventilated by two large, brick shafts, which curve and meet in one at the attic story. In their upward course they pass directly by each school-room, and take foul air by one large opening from each. These same shafts also carry the tin flues for the hot air supply of the rooms, one such flue for each room. The heat lost from the tins goes to keep up the heat of the shaft, and increase the "suction" power. The smoke-flue is utilized in the same way, and there is a "suction coil" for extra heat in the upper part of the flue.

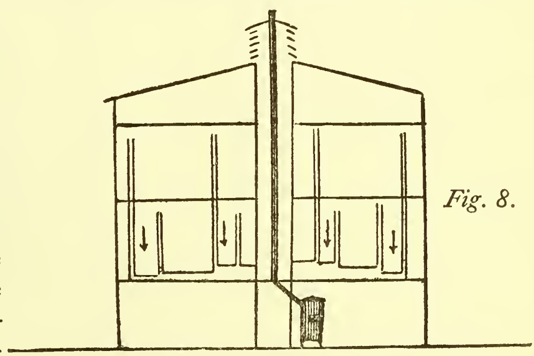
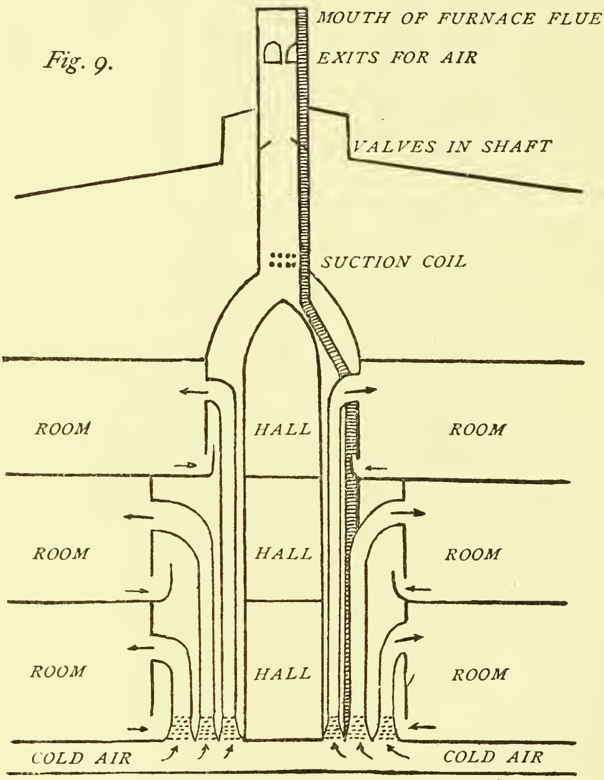


Fig. 8.

With but one inlet and one outlet, there was need for special care in planning the position of the registers. The plan adopted seems to be quite successful in distributing the air and equalizing the temperature. The inlet for hot fresh air is near the ceiling: the current travels towards the windows: a descending current near the windows, originating in the cooling effect of the glass, continues the movement, and finally there is a strong outward movement of air at the inner corner of the room on the level of the floor. Something like a circular movement is thus produced In the diagram (Fig. 10) arrows are introduced at points where currents are felt, and the intervening points may be filled in by the reader's judgment. The figure represents the room in section, with temperature taken

Fig. 9.



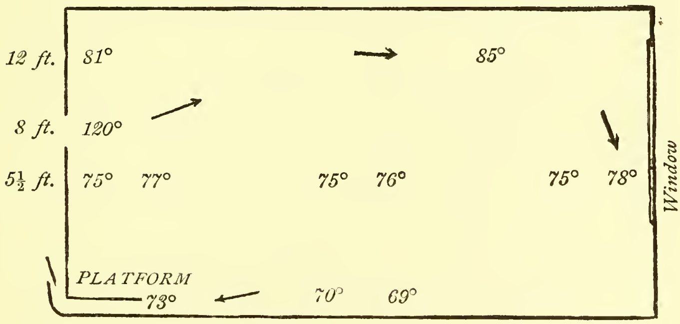
BRIDGEPORT, CONN., HIGH SCHOOL.
Vertical Section.

simultaneously after the apparatus had been in operation forty-five minutes. Similar arrangements have been since made, to the knowledge of the writer, in schools in Auburn, New York, and Newton, Mass., with good success.

The orifice for the exit of foul air ought to be a good deal larger than that for the inlet of fresh air. In examining Fig. 9, the reader is desired to make the correction mentally.

The use of steam power as a ventilating agent is not a novelty in other public buildings, but in school-houses it has been tried, so far as known to the writer, only in Boston, and that within a few weeks past. The experiment is one which it is very desirable to make, by way of testing its economical value. The arrangement consists of a fan placed in the space below the ridge-pole, within a box, propelling the air upwards through the cupola, and exhausting by good-sized flues from below. The motor is a high-pressure engine in the cellar, which seems to require

Fig. 10.



BRIDGEPORT HIGH SCHOOL.

Vertical Section of a Room, showing Temperatures at a height of 1 inch, 5½ feet, 8 feet, 12 feet from floor.

from twelve to fifteen tons of coal during the winter, and the constant presence of an engineer. A new form of engine ("vacuum engine") is proposed, requiring no separate fire, and run by jets of steam from the boiler which heats the school, at an extremely low pressure. No tests for carbonic acid have been made, but the anemometer test, applied in two schools, gave a rate of discharge equivalent to twenty-four cubic feet per head and minute, which is about as much as we can ask for. The expense of introducing the appliances is stated as moderate; flues, not to be considered, being required in any case; vacuum engine (no boiler required), about $500; and fan, something more, besides cost of gearing to transfer power from cellar to attic. In one school a certain amount of rumbling noise is heard (but not complained of), due to vibrating motion in the attic, the apparatus having been introduced not as part of the original plan, but after the school was built. In the other building scarcely any sound was heard.

The arrangement of flues for such a plan has nothing peculiar. It requires chiefly the avoidance of angles, or rough and narrow flues, and is represented in figure 6, the fan being placed at ****, just below where the cupola is set upon the roof.

No system for exhausting air by hot flues or by steam power should be introduced without providing for the introduction of a corresponding amount of fresh-warmed air. Hence it follows that ventilation and heat-

ing constitute parts of one general problem, and that the same mind should plan both.

"Indirect" heating is the only kind worthy of our consideration. In cases where stoves are set in school-rooms, they should be made indirect heaters by the use of screens, as is hereafter described. For larger buildings, steam heat, by means of coils arranged in boxes in the basement, is probably the best. Auxiliary coils may be placed in entries, but not, as a rule, in school-rooms. Ventilation cannot be had without some increase in the bills for fuel. There is reason, however, to think that the amount of increase is not so great as might appear. In our worst ventilated schools there is a good deal of warmed air let out at windows, in an unsystematic way.

Good ventilation implies that cold draughts from open windows are done away with: hence a lower degree of heat in the room is sufficient for comfort. It also implies a rapid change of air, with equalization of temperature, so that the feet are kept warm: this also enables us to be comfortable at a low temperature. A third point, bearing in the same direction, is the greater activity of the circulation and of the change of bodily tissue, and the consequent increase of bodily warmth in fresh air.

The writer has at least twice found opinions strongly expressed in favor of the results of ventilation. Once in a new primary school at Springfield, Mass., where the teachers agreed that they could get along with the thermometer some degrees lower in their new, well ventilated quarters, than formerly was the case in close rooms. The other instance points indirectly in the same way. In the new building of the Massachusetts Institute of Technology, with nearly perfect ventilation, the quality of the work performed is said to be decidedly superior to that which was done in the old building, which has no system worth naming. The ventilation in the new Institute building is very successful. It is effected by a fan in the basement, which forces air through openings in the inner walls of the rooms at a high point, the air escaping by flues in outer walls at low levels. The allowance per hour and head is 1,500 cubic feet in lecture-rooms, and from 2,000 to 4,500 in laboratories of various kinds. The analyses of air gave from 4.87 to 5.23 parts CO_2 in 10,000, in a room which was half full of students. The estimate for a full room would be from 7 to 8 parts per 1,000. Corresponding analyses in the old building gave from 9 to 12.34 in a room with doors and windows open, half full; if filled it would probably stand at 21 or 22 in 10,000. Prof. Woodbridge's estimate of the fuel burned last winter is 307 tons for the old and 404 for the new building, and some allowance is to be made for the fact that all the boilers are situated in the cellar of the older building. Both are of nearly the same size, and are equally used, and for the same purposes.

However encouraging these results, it is seen that perfection is not yet reached. By way of comparison, a few selected data are given, showing the number of parts in 10,000 of CO_2 in the air of various localities. (See table.)

It is probable that the bad air of German schools is one cause of the prevalence of near sight and other defects of vision.

The standard of 6 per 10,000 is not likely to be reached in schools at present. Perhaps we shall have to admit the practical justice of Prof. W. R. Nichols's remark, that 10 in 10,000 is as low as we can expect to find in schools with fair ventilation.

AMERICAN SCHOOLS.

	No. of rooms examined.	Parts CO_2 in 10,000.	Observer.
Philadelphia......1875	9	12.2	E. Thompson.
Boston......1870	40	14.5	A. H. Pearson.
Boston......1875	111	11.9	Draper & Nichols.
Boston...... 1880	39	15.6	W. R. Nichols.
Michigan......	46	22.9	R. C. Kedzie.
New York city......1873	17	20.8	H. Endemann.
Lynn, Mass...... 1883	8	17.5	Prof. Hills.

GERMAN SCHOOLS.

Annaberg, 5 schools......	39.9	O. Krause.
Wilhelm's Gymnasium in March......	55.8	Oertel.
" " in July......	22.9	"
Celle, Gymnasium, various rooms......	20.50	Baring.
Celle, Volks-schulen, most rooms......	90	"
" " one room......	120	"

Much has been said regarding the proper position for outlets and inlets for air. One false view may be corrected at once,—the notion that carbonic acid gas is the agent that is chiefly noxious, and that this gas seeks the lower levels. It is not specially dangerous in quantities found in schools—the animal vapors from skin and lungs are more so—but it represents the degree of organic pollution fairly well. It is not found chiefly at a low level. If there is any difference, the upper levels are sometimes more impregnated, owing to the breath rising in a cool room ; but the difference is small, and, in a room with rapid ventilation, not distinctly traceable. The air from the pupils' lungs may be assumed to be distributed through the apartment rather quickly. The process of ventilation then becomes, not a removal of the exhaled air, but a dilution by the introduction of large quantities of fresh air.

A test for carbonic acid is not easily made in a way to satisfy scientific demands, but an approximate test can be made in a minute by an unskilled person. An ounce of fresh lime-water in a ten-ounce bottle of the air to be tested, shaken vigorously for half a minute, will indicate a fair degree of purity, if it is not distinctly made turbid. One should have a little practice, even at this simple operation.

The writer has endeavored to make a convenient and portable apparatus which will give an indication of the number of parts in 10,000, within a range of error not exceeding one part. To some extent the instrument is successful. It is based on Lange's method. A series of bottles of known size was chosen, graded from large to small, and fitted in a wooden frame. The whole apparatus is carried to the room to be tested. The bottles have been previously filled with water, and when inverted the air fills them at once. They are stoppered, and carried to the laboratory, where a given amount (say one half ounce) of lime-water (chosen as being less liable to change than baryta-water) is introduced into each, and also a few drops of a solution of phenolphthalein, which gives a rose color to the lime-water. By shaking for a good many minutes the carbonic acid is made to neutralize the lime; the approach of complete neutralization is marked by the fading of the rose color; and when satisfied that the process has gone on long enough, we select the largest bottle that shows the complete change, and say,—

The air in this bottle measures (say) 10 ounces; it contains enough CO_2 to neutralize (say) $\frac{1}{2}$ ounce of lime-water: how much CO_2 is here? and how many parts in 10,000 parts of air does it stand for?

The calculation is of course made previously for each bottle, so as to reduce the labor of a test to the mechanical operation. The act of shaking is fatiguing, and the charging of the bottles requires some practice, and a well graduated tube. No figures are here given, but by a comparison with simultaneous analyses made by Pettenkofer's method, an encouraging degree of accuracy has been observed. The point of difficulty in this and similar processes is to determine when the carbonic acid is to be considered as having been fully taken up by the lime. This fault seems to attach to Mr. Owen's ingenious process, given in Billings's "Ventilation and Heating."

Source of Supply of Air. The purity of the source must be carefully guarded. A wooden duct is the usual means of conveying the air across the cellar to the furnace. Such ducts easily open at the joints, and let in cellar air: hence painting from time to time may be useful, unless tin be substituted, or galvanized iron. The interior should be accessible in some way for cleaning, as dust cannot but accumulate with time. The inlet, out of doors, is to be guarded with a wire screen, and is so situated as to be out of the way of mischievous persons. Bad smells are sometimes noticed in a school, which enter through this channel. It is hard to tell, in certain neighborhoods, just where to place the opening. The ground is damp; the air at ten feet is odorous for various reasons; and at thirty feet the smoke of neighboring chimneys is blown into the inlet;—it is

usual, however, to make the cautionary remark that malaria and dampness linger near the ground, and, as a rule, ten feet from the ground is a good place.

Scrupulous cleanliness of the cellar is necessary. If there are water-closets there, they had better not be near the ducts, nor even in the same division of the cellar, since the ducts are provided with doors which are liable to be left open contrary to orders. The misuse of such valve-doors is one of the crying sins of janitors. Many a master has a perpetual warfare with this functionary on account of this. The janitor's object, first and last, is the saving of coal in order that he may receive credit for economy, and his habit is to close the outer valve, opening the one that leads from the cellar, thus feeding his furnace or coils with cellar air at 60° instead of the cold air out of doors. In this way the writer has found a school-house filled with air which must have passed through the furnace two or three times, being drawn down through the entries to the cellar, and then sent back through the furnace. Excessive heating of the air is not so frequent a fault at present as formerly. A report made to the Boston school board in 1846 complains that the air sent to school-rooms is frequently heated to 500° or 600°. This may be simple exaggeration, but there is no doubt that a heat approaching 200° is not uncommon at present. Circumstances alter the requirements greatly, but for schools by daylight, the range should not much exceed 120° F., nor fall much below 80°. In order to fulfil this demand furnaces and boilers should be made very large. Steam heating is one of the best methods. The pressure upon a boiler of proper capacity need never exceed ten—perhaps it should not exceed five—pounds to the square inch, and it should frequently run down to one pound. The danger of explosion need hardly enter into the calculation if there is good management.

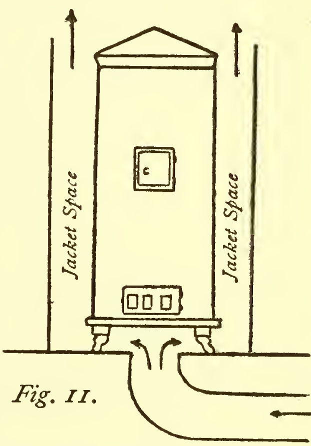


Fig. 11.

Ventilating-Stoves. A useful apparatus for aiding ventilation is furnished by a class of stoves which are provided with an inlet for fresh air, and a chamber for warming it before it is introduced to the room.

Figure 11 shows a stove having a jacket of sheet metal, a space between the jacket and stove, and a fresh-air flue, with a valve operated from the room. The principle, as regards air-supply, is not essentially different from that of the "Fire on the Hearth," the "Jackson Ventilating Grate," and Galton's ventilating fire-places. The method is practically valuable, though the stoves I have seen do not really supply enough air; that is, a stove large enough

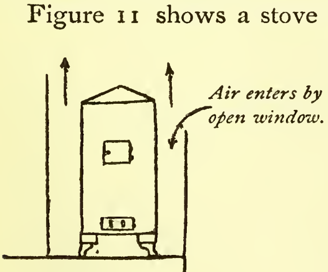


Fig. 12.

to *heat* a given room does not introduce nearly enough air to *ventilate* it. The column of hot air is very short, and the velocity moderate. Yet, where stoves are to be used, there is an obvious gain in using this kind. It ought to be supplemented by a powerful chimney-draught, the chimney being made of liberal size, and heated by the passage of the stove-pipe: an opening for ventilation is to be made near the floor. In still other ways ventilation may be aided by the stove-pipe, as will be seen from Figs. 13 and 14.

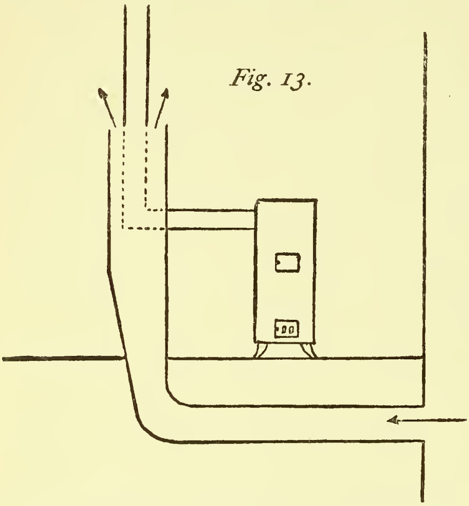


Fig. 13.

Figure 12 shows a screen (supposed to form a semicircle) placed by a stove near a window, which is opened.

Figure 13 is like Fig. 11 in principle.

Figure 14 shows how a lower story may be ventilated.

The last four illustrations are from Billings's "Ventilation and Heating."

The evaporation of water in connection with heaters is probably useful, but the writer is not inclined to consider the matter one of primary importance. It is successfully dispensed with in some of the best ventilated new wards in hospitals.

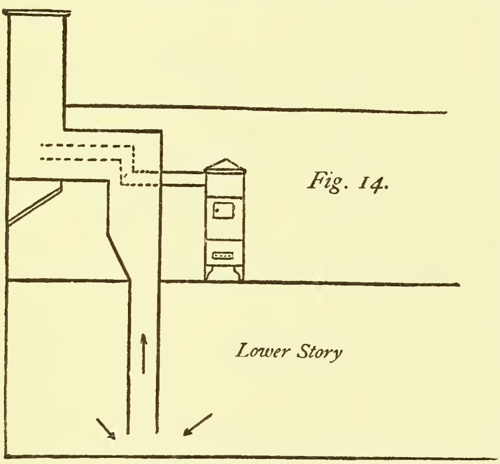


Fig. 14.

Children often come in with cold and damp feet. It is desirable to provide some kind of foot-warmer in the hall or basement. A good one is made of an iron plate, 2½ or 3 inches thick, set on a flat steam-coil.

Opening Windows. This may be regarded in two lights, according as the scholars are *at work*, or *moving and exercising*. To keep windows partly open seems an absolute necessity in many school-rooms. In one-roomed country schools, one of the first steps in sanitation is to insist on the upper sashes being arranged so as to be lowered. An open window is an evil, nevertheless, in cold weather. The palliative measure to be recommended is a strip of board a few inches wide placed so as to deflect the current from under the lower sash, and make it pass above the heads of pupils. This is a decided

mitigation of the draught. It is very often liked in rooms where the ventilation is otherwise bad. A tilting sash at the top of a window cannot safely be used in winter. Such a sash, however, ought to be placed over every room door to enable the occupants to share to some extent in the purer air of the entries. There is no question of the good done by temporary opening of windows and doors for a minute or two while scholars are exercising. The effect may be supposed to disappear in two minutes or so ; but when combined with a short physical exercise in the standing posture, its effect, both moral and physical, is undeniably good. In a very carefully conducted school known to the writer, this is done every hour, the period of five minutes being allotted for that purpose, unless there is a regular recess. At recess time, also, it is the rule that no child shall remain in the rooms, but that all shall go to the play-rooms under charge of their teachers, the windows in the mean time being opened by scholars deputed for the task. These measures, well carried out, greatly relieve the condition of a school which has no efficient system of flue ventilation.

The "Eureka" ventilator is an opening in the wall to let in air directly. It has a valve, and the passage is bent so as to throw the air upwards. It is a useful accessory in some cases where a thorough ventilation is not planned for. Similar openings are often found behind steam-coils in school-rooms. Their utility is delusive ;—they deliver a very small quantity of air, and are liable to be stopped up by accident, or for the purpose of keeping out the cold.

Much has been said of the supposed capacity of cast-iron stoves to let carbonic oxide gas pass out through their pores, thus contaminating the air with a peculiarly deadly poison. The present weight of evidence does not sustain this belief.

IV. SEWERAGE.

It is difficult to trace any large amount of disease in schools directly to offensive privies or sewers. There can be, however, do doubt that some is so caused. The school is often supplied with water from a contaminated well. Bad air and stenches are not always provocative of illness, but the common-sense of civilized races suspects them, and there is no doubt that they may promote debility, headache, loss of appetite and digestive tone, and general depression of vitality ; while in the minds of some physicians there is no doubt that dysentery may be caused, and perhaps typhoid fever, and that scarlatina and diphtheria may be aggravated by exposure to foul air. Pneumonia, tonsillitis, rheumatism, and neuralgia are probably to be included.

Although drainage, as applied to school buildings, is governed by the general rules applicable elsewhere, it may yet be desirable to note, in passing, the chief of these rules. A certain number of points of more special application will be noticed afterwards.

In all houses, whether used for school purposes or not, the drain, soil, and waste pipes ought to be of iron, visible and accessible throughout

their course, if possible; without angles, as straight as possible, and never horizontal. Soil and waste pipes are to be carried up full size, two feet above the house roof, and there guarded against the weather. A trap is to be provided for each sink, basin, urinal, or closet, and a running trap for the outlet of the drain, with an opening from the drain for ventilation, just inside the trap. Safes are to be connected with the drain directly. Rain-water leaders are not to be used for any other purpose, and *vice versa*. The best trap for sinks is, perhaps, the ball trap. Ordinary S traps are often shallow, and are rather more easily siphoned than D traps. Traps are to be ventilated by 1½-inch pipe leading to the general ventilator (*i. e.*, the continuation of the soil or waste pipe) above all other inlets. If not ventilated, the omission must be made upon good authority. Bell traps are convenient for the floors of urinals, but they are rather inefficient unless the seal is made deeper than usual.

In many towns there is a supply of aqueduct water, but no public sewer. In this case the drain usually discharges into a cesspool, loosely built, which permits the escape of fluids into the soil. This arrangement is satisfactory when there is a good deal of spare land, and when the soil is light and gravelly. In a clayey soil it may be entirely inadmissible. If the population is even moderately compact, sewers should be provided at once, under peril of infecting the subsoil air to such an extent as to influence the air of cellars. City schools are usually provided with water-closets proper, or with flush-tanks or iron latrines. In country schools the ordinary privy is almost universal. Good water-closets are doubtless the best arrangement, so long as they are kept in order. No kind yet invented is free from the danger of derangement. A hopper which gives a full and quick discharge of water is probably the best for schools. The discharge may be dependent on the movement of the door or seat, or may be arranged to occur at once in all the bowls at a given signal.

The flush-tank is a long vault of masonry, over which the seats are built. It should have a round bottom and rounded corners. At one end is a tap of water; at the other, in the bottom, a plug to let out the contents. The janitor should remove the plug, and flush and swab the interior at least once a day. With proper ventilation there need be no offensive odors. If placed in a well lighted cellar, it will give satisfaction as long as it is carefully attended to; but such is human nature, that we may expect to find a certain proportion of cases in which due care is not given, and consequently dissatisfaction is felt. There is a great difference of opinion among intelligent heads of schools upon this point, some being unwilling to tolerate these arrangements under the house-roof, while others are strong in support of them. On the whole, it seems better, if we cannot be sure of the future character of the service rendered, to place all of them out of doors. A flush-tank will not freeze in the climate of New York city if emptied at night. In colder places it may be necessary to empty not only the tank (which in any case should be always done), but also the pipes leading to it, directly after school.

An unobjectionable apparatus consists of an iron sink coated inside with a firm glaze, rising to contact with the seats, and only deep enough to hold a few inches of water, with a suitable space above. There should be no riser. The whole should be above ground, in a place moderately warmed; the water to be drawn off daily, and in cold weather not replaced till the next day. For an out-of-doors sink, if iron is used it must not be supplemented by a wall of masonry built above it, as the contraction and expansion of the metal cause a breaking away from the masonry.

As regards freezing, the writer is informed by the superintendent of schools at Springfield, Mass., that it does not occur when the water is shut off from the out-door sinks and drawn off.

A school-house should have one water-closet in-doors, for the use of females. A building of two or more stories may properly have one on each story, in order to save girls the fatigue of climbing stairs in cases where the privilege is desired, and also for the teachers' use.

The urinal appears to present a difficult problem; but the whole matter lies in two words—non-absorbent surfaces and frequent cleaning. One of the best forms is composed entirely of slabs of slate, forming a wall five feet high, with a gutter at its foot. The gutter is cut in the floor-pieces on which the pupils stand. Upright slabs divide the space, in the interest of decency. Slate is almost impervious to moisture, and is made quite so by oiling with linseed oil. The apparatus in question is usually furnished with a perforated water-pipe, to keep the front surface of the stone moistened with a sheet of water. The idea is a good one, but requires such exactness of mechanical work that the jets are rarely in perfect order. It has the further disadvantage of seeming to excuse a part of the duty of scrubbing. No portion—side, base, or back—should be neglected in this respect. All these surfaces are liable to grow foul. The amount of work needed to give thorough cleaning is considerable, but it is the only way to secure purity. The janitor's task ought to be lightened by having the whole floor of the apartment slope towards the gutter, so that the hose can be used freely. Some urinals have a raised platform, in order to define the place to stand on. The better way would be to have a depression, which would equally define the position. A monitor, in either case, should stand by to check irregular behavior.

All complication of structure in these departments should be avoided. Concealment of the basin of a water-closet by wood-work is not desirable, and the wooden seat should be so fitted that it can easily be removed for cleaning or renewal. The urinal needs no trough. It should be made of materials which are not porous: no metal work is admissible, for rust is sure to come, and the animal matter of the urine so saturates the rust that it can hardly be soaked out. Paint soon scales off from metal. Wood can be protected by paint for a time, and then becomes soaked with urine unless repainted. The writer has seen marble used—a material whose absorbent powers may be seen in the large slabs used in restaurants, depots, and such places.

Little need be said about the common privy attached to most country

schools. In many cases this is the last thing attended to. It is practically outside of the teacher's supervision, and one can hardly blame a young and modest woman for failing to see that her duty lies in this direction. It is generally a first-class nuisance as regards odor, insupportable if placed within a convenient distance; but if set off fifty feet or so, the exposure which the pupils undergo in cold or wet weather is a serious matter. In perhaps one half of the cases it is out of repair. The accumulations go on for a year at a time. Finally the walls are covered with dirty scrawls; and very commonly the girls' closet is contiguous to the boys', so that every thing is heard through the partition.

The remedy for a part of these troubles may be found in a more active interest on the part of the school trustee. He can have the place repaired, the scribbling effaced with a plane, and paint applied so as to give a thoroughly neat look. He should try to have both the teacher and the scholars coöperate in maintaining a high standard of neatness, securing, if possible, an occasional visit from the teacher, and making such himself, so as to insure that no breakage or injury goes unnoticed.

Most privies are too dark. Two closets in immediate contact do not insure a proper and modest degree of separation between the sexes: in such a case, the boys and girls should have recess at different times. If there are really two separate out-houses, it is well to have them, and the approaches to them, separated by a sufficient fence. There ought to be plank walks, or raised ways (paved, asphalted, gravelled), to enable the scholars to go dry-shod. But the plan which commends itself to the writer as by all means the best for country schools is the use of dry earth in vaults, emptied weekly, in a shed close to the school-house, and accessible by a short, covered way. It may be thought best to retain the old style of privy for the boys, keeping it at a distance from the house as before; but for girls and little children it is most certainly desirable to have a place which they can reach without danger to health.

Not to mince matters, the direct exposure of a sensitive part of the body to the gusts of a north-east storm is not a thing to be regarded as a trifle; in certain states of the system it may be highly dangerous. And both girls and small children are sometimes led to slight the calls of nature, to their bodily harm, by fear of exposure to bad weather. The plan here suggested is one which may be found illustrated in the report of the Connecticut State Board of Health for 1883.[1] In that report there is given a plan for a country district school, which places both privies under the school roof, but at opposite ends of the structure. Difficulty in keeping the boys' place in order (owing to the need of a urinal) is anticipated, and there is presented, as an alternative, a plan which contains only the girls' closet, as is here recommended.

The figure appended is taken from that report (numbered figure 10—in the present essay, No. 15). It shows a single school-room with separate entrances for the sexes. On the girls' side at the rear is a small, square building, isolated from the main building by an 18-inch passage-

[1] In a paper by the writer of this essay.—SECRETARY.

way around it, but intended to be sheltered by the same roof. The detail of the construction of such a closet is very simple. It requires a receptacle, consisting of a brick trough about two feet wide, rounded at bottom and corners, and coated internally with coal tar to prevent the absorption of fluids or gases. The coating is continued over the top of the bricks and down the front as far as exposed. The bottom is an inverted arch of masonry, bedded in cement and coated with the same, and projecting slightly at the outer end to facilitate removal to buckets. Four feet is a sufficient depth. The bottom ought not to be so low that water from the surrounding land can run into it; and it is better that it should

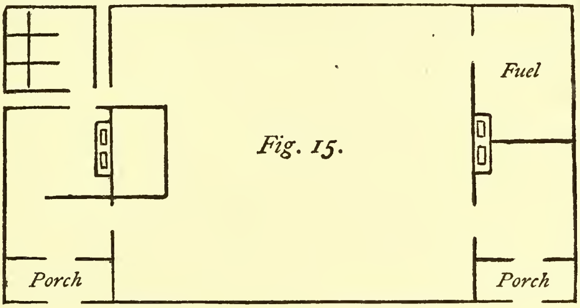


Fig. 15.

be raised above the ground level for convenience in removing the contents. There should be a bin for dry earth in a sheltered place handy for use. Two inches of this earth, finely powdered, are to be spread on the floor of the pit at first, and a little sprinkled on daily: a complete removal is made at the end of each week.

The present writer would corroborate the plan here proposed by cases which he has recently seen, in which the earth removal system is carried out with entire success. An ordinary projection in the rear answers every purpose; the chamber ought, however, to be isolated by a narrow passage-way, furnished with screened windows, which should be kept open. The portable earth-closet may be found useful, but in reality it possesses no advantage over this arrangement.

The only disinfectants required for well arranged water-closets are water, soap, and fresh air. For earth-closets, no more than these and earth are needed. Privies ought not to become offensive: treatment with earth should be resorted to, and if that is thought inapplicable to deep vaults, then let the vaults be shallow for the purpose of speedy removal. But in cases of existing nuisance, or in epidemics of fever, dysentery, or cholera, it is well to be provided with a temporary remedy; and for this purpose, chloride of lime, or corrosive sublimate, as recommended by a committee of the American Public Health Association, may be used. Chloride of lime has the disadvantage of a strong smell. Whichever is used may be prepared by dissolving in soft water chloride of lime (of the best quality) in the proportion of a pound to four gallons, or corrosive sublimate, a pound to twelve gallons. The latter solution is to be colored with permanganate of potash (nine drachms) to prevent mis-

takes. Of the former solution, use a quantity equal to the supposed solid contents of a vault; of the latter, one fourth as much.

If used undissolved, one pound of chloride of lime corresponds to thirty pounds of the solids; one pound of corrosive sublimate to five hundred pounds. Subsequently, chloride of lime may be freely sprinkled over the contents daily. A corrosive sublimate solution may be used for the same purpose, four gallons a day, made by the following formula: Corrosive sublimate and permanganate of potash, of each 2 drachms ($\frac{1}{4}$ ounce), dissolved in a gallon of soft water. This may be kept in a tub or crock, not in a metal vessel. As a precaution in case of an epidemic, wash the interior of the vault daily with this. If green vitriol (sulphate of iron) is used, take a pound and a half to a gallon of water.

V. HYGIENE OF THE EYE.

During the period of school-life, as is now generally known, certain affections of sight increase. It would appear from the uniformity of the results of investigations that the increase is a general rule; and most of those who have treated of the subject have considered it due, in a great degree, to the effect of over-exertion of the eyes in school, more particularly when the light is bad and the rooms unwholesome. It is generally accepted as proved that near-sight is very liable to be inherited. Far-sight (old-sight) is also found in children, and, like near-sight, it increases in frequency and degree as children grow older, until somewhere about the age of fifteen it begins to be less frequent, and at the age of twenty, among students, near-sight decidedly preponderates over far-sight. Dr. E. G. Loring has given diagrams illustrating this fact in the case of three nationalities,—the German, the Russian, and the American. The observers, whose facts are taken for the diagrams, are Conrad, who examined 3,036 eyes of school-children in Königsberg; Erismann, who examined 4,358 eyes of scholars in St. Petersburg; and Derby & Loring, who examined 2,265 eyes in New York schools. The ages in all cases run from the youngest to the oldest pupils, including members of superior schools, up to the age of twenty. In the German table the percentage of near-sighted eyes rises from $11\frac{1}{10}$ in the young children to $62\frac{1}{10}$ in the oldest; in the Russian, from $13\frac{6}{10}$ to $43\frac{3}{10}$ per cent.; and in the American, from $3\frac{1}{2}$ per cent. at six to seven years to $26\frac{78}{100}$ per cent. in the twenty to twenty-first year.

There are a good many other similar series of observations, all agreeing substantially with these, but the German percentages are always very much higher than the American. This is not surprising if school work has anything to do with the result, for German children in all superior schools (real-schulen and gymnasia) are made to do an amount of work which is incredible to our school-boys, and with some results to show in the way of intelligence, too. German children in America also show a decidedly greater percentage of near-sight than American children, owing, no doubt, to hereditary influence. In a board-school in London,

Brudenell Carter has lately found nearly 10 per cent. of near-sight among 267 children. These are the facts, and to most minds they seem to point to a tendency in national life which is truly alarming. It is a distinct drawback to a person's usefulness to have abnormal sight; to have to wear glasses is a serious drawback for many purposes; and yet Germany, which is leading the world in education, is far ahead in respect to near-sight, and we seem to be following her in both points.

There are those, however (as Landolt), who lay the chief stress, as regards causation, upon general conditions of health, maintaining that hardship and poor fare constitute one of the chief causes of near-sight. It may be so, and this is not the place to enter into the argument satisfactorily; but if so, how shall we apply the doctrine to the case of Amherst college, where Derby's strictly accurate statistics show an increase from $44\frac{2}{10}$ to $50\frac{8}{10}$ per cent. during the four years course? In Amherst the conditions of living are as favorable as can be found. Not only is there no "hardship and poor fare," in Landolt's sense, but the young men are under a régime of physical exercise which produces a distinct effect in lessening illness during their residence.

A brief statement of the leading causes, not in any presumed order of frequency, is given here:

1. Inherited tendency.
2. Study while the system is in a weakened condition.
3. Study in a bad light.
4. Study in a bad posture.
5. Study while the eye or brain is fatigued or congested.
6. Study in excess at the formative period of life, when the bodily tissues easily assume a wrong bent.

These will probably cover the ground, so far as relates to our present practical object, pretty nearly. The writer ventures also to offer a series of practical remarks in the form of rules at this point, leaving further discussion till later.

RULES FOR USING THE EYES.

In school work we should require,—

1. A comfortable temperature, and especially let the feet be kept warm and dry.
2. Good ventilation.
3. Clothing at the neck loose. The same as regards the rest of the body.
4. Posture erect;—never read lying down or stooping.
5. Little study before breakfast, or directly after a hearty meal; none at all at twilight or late at night.
6. Great caution about study after recovery from fevers.
7. Light abundant, but not dazzling.
8. Sun not shining on the desk, or on objects in front of the scholar.
9. Light coming from the left hand, or left and rear; under some circumstances from in front.

10. The book held at right angles to the line of sight, or nearly so.
11. Frequent rest by looking up.
12. Distance of book from the eye about fifteen inches.

As regards the causes. No. 2 refers especially to the case of convalescents after measles, scarlet fever, and other weakening fevers. No. 6 requires attention on account of some suggestive remarks made by Dr. Loring in the report referred to. He enlarges on the comparative neglect of out-door life, and the unwholesome habits of eating and living that are found among German children as contrasted with the free play and plenty of fresh air that boys have in our country. He also asserts a belief that since myopia is a disease of childhood, and rarely originates after the age of fifteen or sixteen, it is desirable to give children little severe study until after they have passed that age. More concretely, he points to the life of an English school-boy, with his long hours of foot-ball and cricket, as a better ideal than the German plan.

As regards the rules,—

Nos. 3 and 4 are intended to prevent the occurrence of congestion of the head, which is very likely to injure the eye. A recumbent posture is bad for another reason, viz., because it places the eyeball in unaccustomed positions, disturbing the equilibrium, and deranging the habitual action of the eye muscles.

No. 5. Study before breakfast is usually work done at a disadvantage, since that period is one at which the strength of the system is at a low point in many people. If study is done by artificial light, the trouble is much worse.

No. 7. Some persons are unduly sensitive to light, while others require an amount which is excessive for the average person. Regard may be had to this fact in arranging the pupils. Windows of ground glass, if within the range of sight, are annoying on account of a kind of dazzling effect; if the sun is upon them, they are intolerable.

No. 9. If light comes from the right hand, the pupil's hand in writing shades his work annoyingly. If from the rear, he derives no direct benefit from it unless he turns himself so as to get rid of the shadow; this is the position required in writing by some teachers. A front light, from a window so high that pupils practically are not aware of its presence, is good for the purposes of writing; but such a light can hardly be obtained in a class-room without annoyance. Practically, there must be no windows for scholars to face while employing their eyesight upon tasks. This rule also forbids placing black-boards between windows, so that scholars are obliged to face a full light while trying to read what is written on them. And since the black-board is one of the chief instruments of instruction, and a large extent of it is held desirable, there is an advantage in restricting windows to one side of a room, so that the strip of black-board may run around three sides unbroken, and with every part of it in a good light.

No. 10. The desk lid slopes for the purpose named. It is useful to have light frames for holding books in a more upright position while no

writing is going on. Some desks are made with a joint in the middle of the lid, giving the means of obtaining such an inclined book-holder.

No. 11. The old rule, which punished all who looked up, must be given up. If a pupil is restless and does not apply himself, his case can be reached in various ways, but not by a prohibition of this sort.

No. 12. This distance need not be an invariable one at all times. If generally observed, it will correct the habit of stooping. In teaching penmanship, very great care is needed to prevent the formation of bad habits as regards attitudes. The author has seen a whole roomful of children writing, with their eyes at an average distance of less than three inches from the paper. This exercise must not be engaged in if cloudy weather makes the light poor. Ink should be of a kind that gives a perfectly black mark when first put on paper, not the thin, bluish fluid which is black the next day.

This is the proper place to mention with condemnation the atlases which are often used, crowded with detail in small, delicate letters; also the small, "school" editions of large, standard dictionaries, printed in type which, though clear, is exceedingly fine. Many school-books of our day deserve much praise for their clear, bold type. The use of large-type charts in teaching an entire class is to be commended as avoiding the necessity for a certain amount of poring over books.

Here we may repeat what has already been said about very deep or wide rooms. Many such are wholly unsuited for comfort in writing.

If there is a tendency to near-sightedness, no pains should be spared to prevent a child from getting the habit of holding his eyes too near the book. The distance of fifteen inches is not great; but a child must sit up in order to maintain it. This connects the present topic with the question of school-desks, of which it will be convenient to speak elsewhere. The maintenance of a true posture is dependent on true proportions of desk and seat. When these are obtained, and a child with near-sighted eyes is unable to see clearly at the distance named, it is the opinion of many modern ophthalmologists that he should be furnished with glasses just sufficiently strong for the purpose of desk work. At the same time he may be prevented from crouching down by the use of an apparatus which keeps the head at the distance required. Such an apparatus can be made so as to give no annoyance, and can be kept permanently screwed to the desk. Förster, in 1883, reported several cases of remarkable improvement under this treatment.

Although this is not a place for discussion of the points involved, it may be well to mention that the act of keeping the eyes close to an object is held to involve a muscular effort, both in the act of converging the eyeballs, and also in the (unconscious) act of accommodating the lens by the ciliary muscle, which contributes to the increase of existing near-sight, if it does not originate it. The best light for working purposes comes from above, and is nearly white. This suggests two points:

1. Windows throw light very obliquely on distant objects. It is held by the best authorities that in general they afford sufficient light only

when the distance from the windows does not exceed once and a half times the height of the window itself. This restricts the depth of a room to about twenty feet; a few more may be allowed for the width of an aisle. In one of the handsomest high school buildings in the country the depth from windows to opposite wall is forty feet, which cannot be reconciled with true principles.

2. If light from above is to be sought, the upper part of the window is most valuable, and should be placed within six inches of the ceiling. This greatly improves the illumination of the ceiling, which is itself a very important light-giver. The lower part of the windows is not of so much consequence. It is desirable that they should not be so low as to let in light full upon the face horizontally. If the sill is placed four feet from the floor, no serious loss of light occurs. It is usually stated that if the surface of window-glass is calculated, it should amount to from $\frac{1}{5}$ to $\frac{1}{6}$ of the floor surface. Of course this depends somewhat on the locality. In order to secure the required amount, one side of the room must be made as full of windows as is consistent with the strength of the wall. The tint of the walls should be a neutral shade of blue, quite light. In general, paper is less cleanly than a hard finish.

Blinds should keep out the sun, and admit light and air. They are often poorly made; the rolling slats get out of order. They should be of a light color; natural wood color changes to a dark brown in time, but a light green tint is very pleasant, and admits a sufficiency of light when the sun is shining on the blinds. Solid shutters are not suitable. Curtains ought to be provided. The kind which rolls from the bottom is best, for it cuts off the horizontal light, which is often very annoying to the teacher as well as the scholars, while it leaves the upper part of the window free. If it is thought best to place any windows in the rear end of the room, they should be provided with these shades. Or the windows in that situation may be placed at the height of six or eight feet from the floor.

Projecting "architectural features," as cornices and pillars, are not to be allowed to interfere with windows, or lessen the amount of light entering. Windows must be square at the top.

VI. SCHOOL-DESKS AND GYMNASTICS

Some additional points are here to be given:

1. Support for the feet. This needs special attention in the case of little children. Wooden foot-rests ought to be given when needed.

2. Curves adapted to the body. The seat ought to be "curved," *i. e.*, hollowed. The back in American chairs is usually sloped so as to furnish an easy support in lounging. Some such chairs are so persuasive that one can hardly sit upright in them: this is a great fault, for the school ought to teach an upright carriage of the body. The chairs used in Germany, though the patterns vary greatly, are commonly made upon the principle of supporting only the lower half of the spine, usually by a

short, nearly upright, board. Many of our own chairs might be greatly improved by an approach to this pattern, the principle to be followed being this, that the back of the chair should fit the person closely at the lower part, where the spinal column needs support. I have seen a young lady in a high school suffering a good deal from pain due to the want of support at that point, which was relieved by placing a cushion there, behind the pelvis. No seat that can be devised is suitable for long continued occupancy by healthy children. Their bodily growth is impaired, and deformity is caused by the mere want of bodily activity. A cure for the crooked spine is not, therefore, to be had by carefully adjusting the size of the desk to that of the seat, and by giving the appropriate curves to the latter, but by developing the whole muscular system so that due support shall be given by nature. The deformities which come from this source are more frequent than is thought. Feeble, pale, quiet, over-dressed, a class of girls passes you, "filing" from room to room. You see one in a dozen with rosy cheeks, evidently a country girl. Their shoulders are all round, and they have the droop forward which indicates a want of muscular vigor and deficient expansion of the chest. A part of the impression thus given may be due to the subdued tone and manner of the school-room. The same girls, however, "stay in at recess;" they ride home in the horse-car; their leisure is spent in piano practice, and in going to parties.

There is a potent remedy for these evils in the hands of school boards: it is the practice of gymnastics. In this single measure the entire list of evils called "school maladies" is attacked by giving increased force to the entire physical system. Let pupils in normal schools be first made to appreciate the benefits of the system by applying it to them; let them learn to discard sundry superfluities of dress, by being taught the comforts of "gymnasium dress;" let plain sense, under the title of hygiene, be taught as more important than scientific physiology. If this class of persons can be converted, a permanent benefit accrues to all their pupils in future.

But to return to the subject of desks:

3. In classes, however well graded, great differences of height are noticed. In accordance with this, each class-room in a graded school ought to have at least two sizes of desks; three are desirable.

4. Height of the desk. When the pupil sits upright, and the arms swing freely, the elbows will be just below the edge of the desk, and when bent in writing, will barely clear the edge. Girls require a desk from one half to three quarters of an inch higher.

5. The edge of the desk must come up to a line just over the edge of the seat, or must overlap the seat by an inch or two. This keeps the child from stooping.

Nos. 4 and 5 are of importance as tending to prevent deformity. Too high a desk raises the right or left shoulder unduly. A desk at a distance from the pupil's seat compels him to take a bad posture.

What remains to be said of school gymnastics may be said here. A

good deal may be done with no apparatus at all in the ordinary class-room. Light gymnastics, comprising movements of the arms, are to be practised daily, more for the benefit of the change and for stimulating circulation than for development of body. An hour twice a week will suffice for a more thorough course, with a trained special teacher, in a room devoted to the purpose. No heavy apparatus is recommended,—light wands, dumb-bells of wood, perhaps small clubs. It has been found best for classes exercising together in the Amherst college gymnasium to give up the heavy gymnastics altogether; much more so in schools. Then there are the "free exercises," including proper methods of sitting, standing, lying, walking, running, jumping, as well as exercises in concert, games, etc.

"The aim of these free exercises is to call into action in turn the greater part of the voluntary muscles of the body; and with an intelligent, earnest teacher to direct them, there is no end to the modifications and combinations that can be made, calling for precision, and strict attention, and skill on the part of pupils."[1]

A very valuable work can be done at once, with no special apparatus, and with comparatively little training, by heads of schools who have at command a spare room or a hall with movable seats. The members of upper classes can be instructed by him with perfect success in marching, facing, and a variety of exercises of too complicated a nature to be carried on in the school-room.

There are two present obstacles to the adoption of a complete system of training,—the expense, and the want of trained teachers. The calling of a gymnastic teacher, in fact, is a laborious one. But the matter is one of prime importance, especially in our city schools; and teachers may aid materially in securing the adoption of a thorough system by trying to use the means now in their power.

VII. AFFECTIONS OF THE NERVOUS SYSTEM.

School life is capable of doing much good, as well as harm, to the mental and nervous life of scholars. Over-work, work performed under pressure or at bad seasons of the year, work done in a state of anxiety, are among the causes of injury. The influence of competition for prizes is acknowledged to be bad in a great many cases.

"Double promotions" ought to be watched with care.

As regards over-work, a change in public feeling has come about of late, which has largely led to the abandonment of home study for pupils under the age of (about) twelve years, and has cut down the hours of attendance at school to five in the day. One innovation of modern origin requires to be criticised,—the use of a single session, closing at 1 or 2 P. M., instead of the morning and afternoon session. There should be one long recess in such a session, and arrangements for luncheon may

[1] Dr. J. J. Putnam.

enter with profit into the consideration of the school authorities, for it is unnatural for a growing youth or girl to fast six hours on a stretch amidst vigorous exertion of mind. The fact that some have no appetite for a lunch constitutes ground for suspecting that the school life or work is responsible for the want of appetite.

It is a serious grievance of teachers and scholars that the time of year when the work is hardest is the spring and early summer, the season alike of review, examinations, diplomas, promotions, prizes, all of which is made more trying by "spring sickness" and premature summer heats. At the close of a year's work there should be an approach to relaxation of effort. How difficult it is to secure such a relaxation is well known to teachers. Many a teacher is ready to faint with fatigue before the welcome rest comes. The children do not now suffer so much, their work being rather irregular than severe, for the most part, at those times.

On a matter so familiar to the public as mental over-work and strain among school-children, not a great deal need be said. It is probable that social dissipation does a great deal more harm than school work. Girls, of course, need more watching than boys, for they more readily give up their habits of out-door exercise, and too often have no in-door work whatever to compensate for it. Even among teachers this fault is marked. Their toil is an anxious one, and they require relaxation as much as any profession, but they too often fail to recognize the need. The writer was told by a prominent "kindergarten" teacher, who has teachers under her and instructs others in kindergarten work, that it is a frequent fault among her teachers, as well as her adult pupils, to suppose that they could work in the morning in teaching, attend a class in the afternoon, and go to parties in the evening, the fact being that in this kind of work no teacher ought to consider herself capable of any serious, responsible undertaking outside of her kindergarten ; and the kindergarten hours are from *nine* to *twelve* o'clock !

Without doubt this is very near the truth. Teachers who have five hours' work a day are to be considered as having done a day's work. Seldom, however, is the work completed in that time, for under the new régime a great deal of work is written by the children, and has to be looked over and corrected at home by teachers.

Among positive injuries to the system, and symptoms of injury, the following may be named as often due to school fatigue :

Debility, want of appetite, dyspepsia, sleeplessness, irritability, headache. Other troubles, of less frequent occurrence, are menstrual anomalies, irritable spine, hysteria, chorea, neuralgia. A case of epilepsy is known to the writer, which recurred after five years of health, in a vigorous youth who overworked himself in competing for a prize in *gymnastics*.

Complaints peculiar to females have often been charged to the injury received in going up and down stairs. Derangement, including excess, painful periods, or deficiency, as well as local displacements, have been

noticed. It is certain that the existence of many flights of stairs is complained of, and that young women avoid rooms in the upper stories of boarding-schools in many cases. It may be well to give here a summary of the evidence collected by Geo. E. Smith, M. D., in 1874, in respect to a number of such institutions. The replies amount to the following, substantially:

Answer No. 1. The complaints named are not usually prevalent: there are restrictions upon undue haste in going up or down stairs: should prefer to have no dormitories above the second story.

2. They are very frequent, and are due to this cause.

3. High buildings are bad if there is carelessness in running up and down, not otherwise; improper dress and dissipation are the chief causes.

4. Similar to 3.

5. Rarely due to stairs; due to dissipation: should prefer two-story buildings.

6. Not due to stairs, but to lacing, heavy skirts, and over-work.

7. Dress, corsets, and stair-climbing are far more to blame than study.

8. Stairs are a great evil while girls are dressed as they are now.

The matter has been touched upon in another division of this essay.

VIII. CONTAGIOUS DISEASE IN SCHOOLS.

The diseases intended by the title are diphtheria, scarlet fever, measles, and small-pox.

There is little need to enforce by argument the importance of the subject. There is a pretty general feeling that the matter of complaint is not an imaginary one. In the report of the Massachusetts State Board of Health (ninth) a large number of letters from physicians are cited or referred to, all, with scarcely an exception, acknowledging the danger of contagion to be real. There is, however, a mass of ignorance and blindness in the lower social strata which cannot be expected to pay the slightest heed to ordinary precautions for preventing contagion until forced to do so. The means for bringing such heedless persons to their duty now exist in many places in the form of local ordinances or school regulations. Such regulations should be something like the following:

1. The existence of a case of the above named diseases should exclude from school all inmates of the house in which it prevails, until competent authority decides that it is safe for them to return to school.

2. Teachers, school officers, or physicians should report cases coming to their knowledge at once, whether such cases are in their own school or not. The child affected is to be sent home at once, and the parents informed of the law.

3. Contagion being easily spread by pupils after recovery by means of clothing or fine particles of epidermis, etc., it is necessary to establish rules for disinfection, whether of the premises and clothing, or of the patient's body, the proper performance of such disinfection, and the lapse of a suitable time, being ascertained upon good authority.

4. Evidence of vaccination should be required of all children entering the public schools, and revaccination should be recommended to pupils at a later date, especially during epidemics of small-pox.

Contagious affections of the skin, and spasmodic diseases (itch, scald head, ring-worm, epilepsy, St. Vitus's dance, habitual hysteric attacks), are deserving of attention, as liable to occur at any time in a city school. Teachers should have some knowledge of what is to be done in such cases, and should be authorized to complain to school governments. The convulsive affections named are, some of them, contagious through imitation, and must be excluded unless there seems good reason for the contrary course.

IX. SANITARY SUPERVISION.

As a corollary to all that has been said, we must consider how the facts can be made operative in and upon the schools. In many school boards, one person—or a committee—is charged with matters pertaining to the health of scholars. For most places this plan is the desirable one. In large places, including cities of all sizes, a natural means to this end is the appointment of one or more persons charged with the enforcement of regulations based on sanitary principles. This plan will soon be tested thoroughly; the only difficulty (or rather, the only question) seems to be in relation to the extent of the duties and functions of such officers.

The cities of Elmira, N. Y., and Boston, Mass., each have an officer, a physician, who acts as medical supervisor. In the latter place he is entitled "Instructor in Hygiene," the peculiarity of the designation being due to certain technical difficulties in the local statutes. Here it may be truly said that the field for one man's exertions being unlimited, and far beyond any man's capacity to fill, it is open to the incumbent's discretion to select the most necessary objects for his first attention. At present the inspection of the buildings forms the leading object in Boston. Instruction in hygiene is also given by means of lectures addressed to teachers. That such an officer should be a physician requires no proof.

How great the opportunity for work may be in certain cases is shown by that of the city of Brussels, which (for European ideas) presents a model in this respect. This city, with a population of 183,000 and thirty-three public schools, has a staff of medical visitors sufficient in number to make a *weekly* visit, with personal attention, to each pupil. In one respect their duties go beyond what is likely to be thought advisable in America at present,—they give medical treatment to a large number of pupils at school. The number thus treated for the three years 1876–'79 was 446, 732, 1,118, besides which, during the same three years, there were 2,885 cases of dental treatment. Among the chief duties of such an officer should be those of inspection of buildings, and of instruction of teachers in the principles of hygiene as applicable to their charges. Sanitary rules may be proposed by him, and he will have a great opportunity of rectifying errors in sanitary administration due to mere ignorance. He will not take from members of the school board their right to be

interested, but he can greatly increase the interest if he knows how to use his knowledge of the subject. It need not be said that there are some points where the field is already occupied, as the matter of public vaccination, and other means for guarding against contagion—matters usually in the hands of town or city boards of health. Where these points are not thus arranged, the school inspector should have them in charge.

DISINFECTION AND INDIVIDUAL PROPHYLAXIS AGAINST INFECTIOUS DISEASES.

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DISINFECTION AND INDIVIDUAL PROPHYLAXIS AGAINST INFECTIOUS DISEASES.

INTRODUCTION.

Definition. We are met at the outset by a difficulty growing out of the fact that the word *disinfection*, as commonly used, has a very different signification from that to which certain recent authors would restrict it. Thus, the Committee on Disinfectants of the American Public Health Association defines a disinfectant as "an agent capable of destroying the infective power of infectious material."[1] In the preliminary report of this committee the reasons for restricting the meaning of the word within the limits justified by its etymology, and of our knowledge of the nature of "infectious material," are very clearly stated, as follows:

"The object of disinfection is to prevent the extension of infectious diseases by destroying the specific infectious material which gives rise to them. This is accomplished by the use of disinfectants.

"There can be no partial disinfection of such material: either its infecting power is destroyed, or it is not. In the latter case there is a failure to disinfect. Nor can there be any disinfection in the absence of infectious material. * * * * * *

"Popularly, the term disinfection is used in a much broader sense. Any chemical agent which destroys or masks bad odors, or which arrests putrefactive decomposition, is spoken of as a disinfectant. And in the absence of any infectious disease it is common to speak of disinfecting a foul cesspool, or a bad-smelling stable, or a privy vault.

"This popular use of the term has led to much misapprehension, and the agents which have been found to destroy bad odors—deodorizers,—or to arrest putrefactive decomposition—antiseptics,—have been confidently recommended and extensively used for the destruction of disease germs in the excreta of patients with cholera, typhoid fever, etc.

"The injurious consequences which are likely to result from such misapprehension and misuse of the word disinfectant will be appreciated when it is known that recent researches have demonstrated that many of the agents which have been found useful as deodorizers, or as antiseptics, are entirely without value for the destruction of disease germs.

"This is true, for example, as regards the sulphate of iron or copperas, a salt which has been extensively used with the idea that it is a valuable disinfectant. As a matter of fact, sulphate of iron in saturated solution does not destroy the vitality of disease germs, or the infecting power of

[1] *The Medical News*, Phila., Jan. 24, 1885, p. 87.

material containing them. This salt is, nevertheless, a very valuable antiseptic, and its low price makes it one of the most available agents for the arrest of putrefactive decomposition in privy vaults, etc.

"Antiseptic agents also exercise a restraining influence upon the development of disease germs, and their use during epidemics is to be recommended when masses of organic material in the vicinity of human habitations cannot be completely destroyed, or removed, or disinfected.

"While an antiseptic agent is not necessarily a disinfectant, all disinfectants are antiseptics; for putrefactive decomposition is due to the development of 'germs' of the same class as that to which disease germs belong, and the agents which destroy the latter also destroy the bacteria of putrefaction, when brought in contact with them in sufficient quantity, or restrain their development when present in smaller amounts.

"A large number of the proprietary 'disinfectants' so called, which are in the market, are simply deodorizers or antiseptics of greater or less value, and are entirely untrustworthy for disinfecting purposes."[1]

The offensive gases given off from decomposing organic material are no doubt injurious to health; and the same is true, even to a greater extent, of the more complex products known as *ptomaines*, which are a product of the vital—physiological—processes attending the growth of the bacteria of putrefaction and allied organisms. It is therefore desirable that these products should be destroyed; and, as a matter of fact, they are neutralized by some of the agents which we recognize as disinfectants, in accordance with the strict definition of the term. But they are also neutralized by other agents—deodorants—which cannot be relied upon for disinfecting purposes, and by disinfectants, properly so called, in amounts inadequate for the accomplishment of disinfection. Their formation may also be prevented by the use of *antiseptics*. From our point of view the destruction of sulphureted hydrogen, of ammonia, or even of the more poisonous ptomaines, in a privy vault, is no more disinfection than is the chemical decomposition of the same substances in a chemist's laboratory. The same is true as regards all of the bad-smelling and little known products of decomposition. None of these are "infectious material," in the sense in which we use these words; that is, they do not, so far as we know, give rise *directly* to any infectious disease. Indirectly they are concerned in the extension of the epidemic "filth diseases," such as cholera and yellow fever, and of the fatal endemic "filth diseases," such as typhoid fever and diphtheria, which in the long run claim more victims than do the pestilential maladies first named. This because persons exposed to the foul emanations from sewers, privy vaults, and other receptacles of filth, have their vital resisting power lowered by the continued respiration of an atmosphere contaminated with these poisonous gases, and are liable to become the victims of any infectious disease to which they may be exposed. Moreover, the accumulations of filth which give off these offensive gases furnish pabu-

[1] *The Medical News*, April 18, p. 425.

lum upon which certain disease germs thrive; and it may happen that the bad smelling air carries something worse than the poisonous gas which makes its presence known by offending the sense of smell. It may waft to our nostrils infectious particles which are beyond recognition by any sense, unless it be the sense of sight with the aid of a good microscope.

We desire, moreover, to have it fully understood that in restricting the meaning of the term disinfection within the limits given by the definition of the Committee on Disinfectants of the American Public Health Association, we do not wish to limit the practice of "disinfection," in the popular sense of the word.

It is but fair to say, also, that this popular usage is supported by good authority, and until quite recently has been the common acceptation of the term among physicians and chemists. Indeed, it is but a short time since the nose test was the only test of "disinfection" recognized by many intelligent persons.

Littré, in his Dictionary of the French Language, defines disinfectants as "substances which destroy, chemically, bad odors."

Vallin, the author of the best modern treatise upon "Disinfection and Disinfectants," says,—

"From a scientific point of view there is perhaps an impropriety in introducing into the idea of disinfection the suppression of odors which offend the sense of smell. The bad odor is not injurious in itself; it is an epiphenomenon, which does not necessarily give the measure of the hurtful properties of the air, or of any substance whatever. The public, unacquainted with medicine, has an unfortunate tendency to judge of insalubrity by the bad odor: the absence of this gives to it a deceitful security: when they are masked by any device, it [the public] believes that all danger has been removed. *Nevertheless it is necessary to avoid violating the ordinary sense of words.*[1] An atmosphere which does not in the least offend the sense of smell may certainly be insalubrious, and engender the gravest maladies; but the fetid or disagreeable odors may reveal the presence of injurious principles, of toxic gases, or of organic matter in decomposition. We should not too much diminish the importance of these offensive odors in the eyes of the public: everything which smells badly is to be suspected."[2]

We agree with Prof. Vallin, that the bad odors should arouse suspicion, and lead to the use of deodorants, or of antiseptics, or of disinfectants, if required; but let us not leave the public to suppose that when the bad odors have been neutralized, the offensive material has been disinfected. Let us rather instruct the public that to deodorize and to disinfect are not one and the same thing, and that deodorant and disinfectant are not synonymous terms. For our part we prefer to "violate the ordinary sense" of the word, and to restrict its signification within such limits

[1] Italics by present writer.

[2] Op. Cit., p. 2.

as will prevent confusion, and, what is far worse, a reliance upon inefficient methods for the destruction of infectious material.

In the present essay we shall use the words disinfection and disinfectant, in accordance with the definition of the committee on disinfectants already given. But, inasmuch as this is intended to be a practical treatise for popular use, we shall also give, in the proper place, directions for the use of deodorants and of antiseptics, so that "disinfection," in the broad sense in which the word is commonly used, may be fully considered.

Tests of Disinfection. What means have we of proving that the infective power of infectious material has been destroyed?

Evidence of disinfection may be obtained (a) from the practical experiments—experience—of those engaged in sanitary work: (b) by inoculation experiments upon susceptible animals; (c) by experiments made directly upon known disease germs.

(a) It is a matter of common experience, that when a room has been occupied by a patient with an infectious disease, such as small-pox, scarlet fever, or diphtheria, susceptible persons are liable to contract the disease weeks or even months after the patient has been removed from it, unless in the mean time it has been disinfected. If a second case does occur from exposure in such a room, it is evident that it has not been disinfected. But the non-occurrence of subsequent cases cannot always be taken as evidence that the means of disinfection resorted to were efficient. Negative evidence should be received with great caution. In the first place, the question as to whether susceptible individuals have been fairly exposed in the disinfected room must be considered. Then it must be remembered that susceptible persons do not always contract a disease, even when they are exposed in a locality known to be infected. A further difficulty in estimating the value of evidence obtained in practice arises from the fact, that, in connection with the special means of disinfection resorted to, such as fumigation, hanging up cloths saturated with a disinfecting solution, etc., it is customary to resort to additional precautionary measures, such as washing surfaces with soap and hot water, white-washing plastered walls, and free ventilation. It is apparent that under these circumstances it would be unsafe to accept the fact, that no other cases occurred in a room treated in this way, as evidence that the particular disinfectant used is efficient for the destruction of the infectious agent of the disease in question. The fond mother who attaches a charm to her child's neck to protect it from evil, also takes the precaution of guarding it from contact with other children who are sick with any infectious disease. If her child fortunately grows to manhood or womanhood without having suffered an attack of scarlet fever or diphtheria, she may imagine that her charm has protected it, but the evidence upon which her faith is founded is not of a nature to convince those who are familiar with scientific methods of demonstration. "Well educated" persons are often ready to testify in favor of methods of disinfection, or of treatment, upon evidence which, from a scientific point of view, has no more value than that which the fond mother in question has

to offer in favor of the little bag containing camphor or assafœtida, or some other charm of equal value, which she has attached to her child's neck to keep it from catching scarlet fever or diphtheria at school. On a par with these charms, so far as disinfection is concerned, we may place the saucer of chloride of lime, which it was formerly the fashion to place under the bed of a patient sick with an infectious disease, the rag saturated with carbolic acid, or chloride of zinc, suspended in the sick-room, and even the fumigations with burning sulphur, as sometimes practised by those who are unfamiliar with the evidence as to the exact value of this agent, and the conditions necessary to ensure successful disinfection with it.

Chloride of lime, sulphurous acid gas, and carbolic acid are among our most useful disinfecting agents, but disease germs are not to be charmed away by them any more than by a little bag of camphor.

Having pointed out the fact that negative evidence, in a restricted field of observation, must be accepted with great caution in estimating the value of disinfectants, we hasten to say that the combined experience of sanitarians, derived from practical efforts to restrict the extension of infectious diseases, is of the greatest value, and that this experience is to a great extent in accord with the results of exact experiments made in the laboratory.

(b) Inoculation experiments upon susceptible animals, made directly with infectious material which has been subjected to the action of a disinfectant, have been made by numerous observers. The proof of disinfection in this case is failure to produce the characteristic symptoms which result from inoculation with similar material not disinfected. Thus, Davaine found that the blood of an animal just dead from the disease known by English writers as anthrax or splenic fever (Fr. *Charbon*), inoculated into a healthy rabbit or Guinea-pig, in the smallest quantity, infallibly produces death within two or three days; and the blood of these animals will again infect and cause the death of others, and so on indefinitely. This anthrax blood therefore was infectious material, which could be utilized for experiments relating to the comparative value of disinfectants. Davaine made many such experiments, not only with the blood of anthrax, but also with that of a fatal form of septicæmia in rabbits, which is known by his name. Other investigators have followed up these experiments upon infectious material of the same kind, and also upon material from other sources—*e. g.*, the infectious material of glanders, of tuberculosis, of symptomatic anthrax, of fowl cholera, of swine plague, etc.

It has been proved that the infectious agent in all of the diseases mentioned is a living germ, and that disinfection consists in destroying the vitality of this germ. But in experiments made with blood or other material obtained directly from diseased animals, the results would be just as definite and satisfactory if we were still ignorant as to the exact nature of the infecting agent. The test shows the destruction of infecting power without any reference to the cause of the special virulence,

which is demonstrated to be neutralized by certain chemical agents in a given amount. All of the experiments made with the above mentioned kinds of virus have been made upon the lower animals; but there is one kind of material which it is justifiable to use upon man himself, and with which numerous experiments of a very satisfactory character have been made. This material is vaccine virus. Fresh vaccine, when inoculated into the arm of an unvaccinated person, gives rise to a very characteristic result,—the vaccine vescicle. The inference seems justified that any agent which will neutralize the specific infecting power of this material will also neutralize the small-pox virus. Thus far it has not been definitely proved that the infective agent in vaccine virus is a living germ; but the numerous experiments made have shown that the chemical agents, which have the power of destroying the various kinds of infectious material heretofore mentioned, have also the power, in about the same amounts, of neutralizing vaccine virus, as shown by its failure to produce any result when inoculated into an unvaccinated person. In these experiments the more careful investigators have taken the precaution of vaccinating the same person with disinfected and with non-disinfected virus from the same source. A successful vaccination with the non-disinfected virus shows that the individual is susceptible, and the material good: failure to produce any result is evidence that the potency of the disinfected virus has been destroyed by the chemical agent to which it was exposed.

(c) As already stated, it has been demonstrated that the infectious diseases of the lower animals, which have furnished the material for experiments upon disinfectants by the method of inoculation, are "germ diseases," and that the infectious agent is in each case a living micro-organism, belonging to the class known under the general name of *Bacteria*. The bacteria are vegetable organisms, which, by reason of their minute size and simple organization, must be placed at the very foot of the scale of living things. But they make up in number and in rapidity of development for their minute size; and there is good reason for believing that the infectious diseases of man are also caused by pathogenic—disease-producing—organisms of the same class. Indeed, this has already been proved for some of these diseases, and the evidence as regards several others is so convincing as to leave very little room for doubt.

Many of these disease germs are now known to us, not only by microscopic examination of the blood and tissues of infected animals, but also by "culture experiments." That is, we are able to cultivate them artificially in suitable media, and to study their mode of development, etc., in the laboratory, quite independently of the animals from which our "pure cultures" were obtained in the first instance. The culture fluids used are prepared from the flesh of various animals; and when to one of these a certain quantity of gelatine is added, we have a "solid culture medium," upon the surface of which some of these germs will grow most luxuriantly. To start such a "culture," it is only necessary to transfer, with proper precautions, a minute quantity of the infectious

material to the surface of our culture medium, or into a fluid which has been found to be suitable for the growth of the particular organism which we desire to cultivate. A second culture is in the same way started from the first, and so on indefinitely.

Now it is evident that these "pure cultures" furnish us a ready means for testing the power of various chemical agents to destroy the vitality of known disease germs, as shown by their failure to grow in a suitable culture medium after exposure for a given time to a given percentage of the disinfectant. Very many experiments of this nature have been made during the past three or four years. The reader who desires fuller details as to the method of conducting such experiments, and of the results obtained, is referred to the preliminary reports of the committee on disinfectants, of the American Public Health Association, published during the current year (1885) in the *Medical News*, Philadelphia, and which will, doubtless, also be published in full in the next annual volume of the association. We may say here, that the experimental data on record indicate that those agents which are efficient for the destruction of any one of the pathogenic organisms upon which experiments have been made, or of harmless species of the same class,—*e. g.*, the bacteria of putrefaction,—are efficient for the destruction of all, *in the absence of spores.* There is, it is true, within certain limits, a difference in the resisting power of different organisms of this class to chemical agents. This is not, however, sufficiently marked to prevent the general statement that *a disinfectant for one is a disinfectant for all*, *in the absence of spores.*

The last clause of the above statement calls for an explanation, and certain details with reference to the mode of reproduction of disease germs. All of the bacteria multiply by binary division; that is, one individual divides into two, and each member of the pair again into two, and so on. The spherical bacteria, known as *micrococci*, multiply only in this way, but the rod-shaped bacteria, or *bacilli*, also form spores. These spores correspond with the seeds of higher plants. They are highly refractive, oval or spherical bodies, which, under certain circumstances, make their appearance in the interior of the rods, which cease to multiply by binary division when spore formation has taken place. The point of special interest with reference to these spores is, that they have a resisting power to heat, and to the action of chemical disinfectants, far beyond that which is possessed by micrococci, or by bacilli without spores. The difference may be compared to the difference between a tender plant and its seeds to deleterious influences, such as extremes of heat and cold. Thus the spores of certain species of bacilli withstand a boiling temperature for several hours, while a temperature of 150° Fahr. quickly kills most bacteria in the absence of spores. A similar difference is shown as regards the action of chemical agents. Certain agents,—*e. g.*, sulphurous acid gas and carbolic acid,—which are extensively used as disinfectants, have been proved by exact experiments to be quite impotent for the destruction of spores. This being the case, it is advisable,

in practical disinfection, always to use an agent which has the power of destroying spores, in those cases in which the exact nature of the disease germ has not been demonstrated. The cholera germ of Koch does not form spores; and there is good reason to believe that the same is true as regards the germs of yellow fever, of scarlet fever, and of small-pox, which have not yet been demonstrated. This inference is based upon evidence obtained in the practical use of disinfectants, and upon certain facts relating to the propagation of these diseases.

A second general statement, which is justified by the experimental evidence on record, is, that *agents which kill bacteria in a certain amount, prevent their multiplication in culture fluids, when present in quantities considerably less than are required to completely destroy vitality.*

An agent, therefore, which, in a certain proportion and in a given time, acts as a "germicide" in a smaller quantity, may act as an *antiseptic*, *i. e.*, may prevent putrefactive decomposition by restraining the development of the bacteria of putrefaction. Antiseptics also prevent or retard the development of pathogenic bacteria. It follows from this that germicides are also antiseptics; but the reverse of this proposition is not true as a general statement, for all antiseptics are not germicides. Thus alcohol, common salt, sulphate of iron, and many other substances which are extensively used as antiseptics, have scarcely any germicide power, even in concentrated solutions, and consequently would be entirely unreliable as disinfectants.

Practically, antiseptics may accomplish the same result in the long run as we obtain in a short time by the use of disinfectants. If, for example, we prevent the development of the germs of cholera, or of typhoid fever, in an infected privy vault, by the continued use of antiseptics, these germs will in time lose their ability to grow, when introduced into a suitable culture medium. But in the meantime there is always the possibility that some of them may escape, with the fluid contents of the vault, into the surrounding soil, and contaminate some well or stream from which drinking-water is obtained. For this reason privy vaults, cesspools, and sewers should never be allowed to become infected. All infectious material, such as the dejections of patients with cholera or typhoid fever, should be destroyed at its source, in the sick-room; or, if it is ascertained that such material has been thrown into a privy vault, the entire contents of the vault should be promptly disinfected. The same rule applies to infectious material thrown upon the ground, or wherever it may be.

Finally, we desire to emphasize the following propositions:

Disinfection consists in extinguishing the spark, killing the germ, which may light up an epidemic in the presence of a supply of combustible material—filth.

The object of *general sanitary police* is to remove this combustible material out of the way, so that no harm may result even if the spark be introduced.

Antiseptics and deodorants are useful when it is impracticable to remove offensive organic material from the vicinity of human habitations, but they are a poor substitute for cleanliness.

PART FIRST.

DISINFECTION.

It will be our aim in the present chapter to give reliable, practical directions with reference to the use of disinfectants, and the best methods of disinfection. Keeping this object in view, we shall recommend for disinfecting purposes only those agents named in the following list:

Group 1.

Disinfectants which have the power of destroying spores:

1. Fire.
2. Steam under pressure (25 lbs.).
3. Boiling water.
4. Chloride of lime (in solution).
5. Liquor sodæ chlorinatæ.
6. Mercuric chloride (in solution).

Group 2.

Disinfectants which are effective in the absence of spores:

7. Dry heat (230° Fahr. for two hours).
8. Sulphur dioxide.
9. Carbolic acid.
10. Sulphate of copper (in solution)
11. Chloride of zinc (in solution).

NOTE. In the present state of knowledge, a division of disinfecting agents into two groups becomes necessary, unless we would entirely dispense with the use of those agents named in our second group, which cannot be relied upon for the destruction of spores, and consequently cannot be recommended for the destruction of all kinds of infectious material. As this group includes several agents which are extensively used for disinfecting purposes, and which we believe to possess great practical value, we have considered it necessary to make this distinction. The present state of science, however, does not enable us to classify all infectious diseases in the same way, and in case of doubt it will always be advisable to use those agents included in Group 1. But in the absence of a precise knowledge of the nature of the germ, we may in certain cases be governed by the practical experience of sanitarians, and by experiments which have been made directly upon infectious material, *e. g.*, on vaccine virus. In our recommendations we have taken account of this kind of evidence, as well as of laboratory experiments, in which known disease germs or harmless organisms of the same class have served as the test of disinfecting power.

We shall first give a brief account of the conditions of successful disinfection with these agents, as established by experimental data, and afterward detailed directions for their employment under the various circumstances in which disinfection is required.

1. Fire. It is hardly necessary to say that burning of infectious material, infected clothing, etc., is an effectual method of disposing of it. This method of disinfection is always to be recommended, when practicable or consistent with a due regard for economy and the rights of individuals. As a rule, articles of little value, which have been soiled with infectious material, had better be burned; and this is especially true of old clothing and bedding. But we have other efficient methods of

disinfection, which make it unnecessary to sacrifice articles of value except under unusual circumstances.

2. *Steam under Pressure.* The disinfecting power of steam given off from boiling water in an open vessel does not differ from that of the water itself, but confined steam has a temperature corresponding with the pressure as indicated by a steam gauge. At twenty pounds pressure the temperature is about 230° Fahr. (105° C.) ; at twenty-five pounds it is about 240° Fahr. ; at thirty pounds it is 250° Fahr. Moist heat at the lowest temperature named destroys the most resistant spores in twenty minutes, while a temperature of 240° Fahr. is effective almost immediately.[1]

3. *Boiling.* In the absence of spores, bacteria are quickly killed at a temperature considerably below the boiling point of water, and it is safe to say that boiling for half an hour will destroy all known disease germs, including the spores of anthrax, which have less resisting power than the spores of certain harmless and widely distributed bacilli, which have been found to resist boiling for several hours.

4. *Chloride of Lime* (chlorinated lime, bleaching powder). This is one of the cheapest and most efficient of disinfectants. It should be packed in air-tight and moisture-proof receptacles,—glass is preferable,—and should contain at least 25 per cent. of available chlorine.[2] It should be used in solution, which had better be made as required. An insoluble residue will be left, which may be removed by filtration or decantation. This, however, is not at all necessary. Chlorinated lime owes its disinfecting power to the presence of the hypo-chlorite of lime, a salt which is freely soluble in water, and which is quickly decomposed by contact with organic matter. Germs of all kinds, including the most resistant spores, are destroyed by this solution, but it must be remembered that the disinfectant itself is quickly decomposed and destroyed by contact with organic matter, and that if this is present in excess, disinfection may not be accomplished, especially when the germs are embedded in masses of material which are left after the hypo-chlorite of lime has all been exhausted in the solution.

5. *Liquor Sodæ Chlorinatæ* (Labarraque's solution). This is a solution of the hypo-chlorite of soda. Its value as a disinfectant corresponds with that of solutions of the hypo-chlorite of lime of the same strength. The preparations in the market vary greatly in value, and some of those tested by the committee on disinfectants[3] were found to be practically without value. This is due to the fact that the solution does not keep well. For this reason, and on the score of economy, a solution of chloride of lime will be preferable for most purposes. Labarraque's solution is, however, a more pleasant preparation for bathing the surface of the body, and both as a deodorant and a disinfectant will be found useful in

[1] See Preliminary Report of Committee on Disinfectants, in *The Medical News*, Philadelphia, March 14, 1885, p. 284.

[2] The test for available chlorine is given in Preliminary Report No. 11 of the Committee on Disinfectants, l. c., Jan. 7, p. 148.

[3] l. c., p. 659.

the sick-room. It should contain at least 3 per cent. of available chlorine.

6. *Mercuric Chloride* (bichloride of mercury, corrosive sublimate). This salt is well known as a deadly poison, which has long been used in domestic practice as a "bug poison." Recent researches show that it has germicide powers of the first order, and it is consequently a disinfectant which may be recommended for certain purposes, due regard being had to its poisonous nature, and to the fact that it is decomposed by contact with lead, tin, or copper, and that lead pipes are soon rendered brittle and worthless by passing through them solutions of mercuric chloride. Its potency in dilute solutions (1 : 500 to 1 : 4000) makes it comparatively cheap,[1] and the danger of accidental poisoning from such dilute solutions is not very great. The concentrated solutions should be colored, as a precaution against accident, for they have neither color nor odor to reveal their deadly nature.

A standard solution which contains four ounces to the gallon of water is of convenient strength for a concentrated solution, to be issued by manufacturers or health authorities, in properly labelled bottles. This may be colored with permanganate of potash,[2] or with indigo, or with aniline blue. Inasmuch as standard solution No. 2 of the committee on disinfectants is colored with the permanganate, it would perhaps be better to give this solution a blue color. The writer would suggest the following formula, in which another poisonous metallic salt contained in our list is combined with the mercuric chloride:

Bichloride of mercury, ...	4 ounces.
Sulphate of copper, ...	1 pound.
Water, ...	1 gallon.

It must be remembered, in using this and other disinfecting solutions, that the condition relating to time of exposure to the action of the disinfecting agent is an important one. The experimental evidence[3] relating to the germicide power of mercuric chloride shows that the time of exposure being two hours, this salt may be safely recommended for the destruction of spore-containing infectious material in the proportion of 1 : 1000, and of pathogenic organisms in the absence of spores in the proportion of 1 : 4000, or even less, *provided that the micro-organisms to be destroyed are fairly exposed to its action.* The fact that mercuric chloride combines with and coagulates albuminous material, interferes to some extent with its value as a disinfectant, and will be kept in view in the recommendations to be made hereafter relating to the practical use of this agent. Mercuric chloride is an efficient antiseptic in the proportion of 1 : 15,000, and it exercises a restraining influence upon the development of the spores of the anthrax bacillus, when present in culture solutions, in the proportion of 1 : 300,000, and even less.

[1] It costs about fifty cents a pound by the quantity.

[2] Ten grains to the gallon is sufficient.

[3] *The Medical News*, Feb. 21, p. 205.

7. *Dry Heat.* Dry heat is only to be recommended for the disinfection of such articles as would be injured by exposure to moist heat, or to a disinfecting solution. A properly constructed disinfection chamber or "oven" is absolutely essential, if dry heat is to be used. The experimental evidence on record[1] shows that the destruction of spores requires a temperature which would injure woollen fabrics (140° C. for three hours). In the absence of spores, however, articles which are freely exposed for two hours to a temperature of 110° C. (230° Fahr.) may with safety be considered disinfected. In practice it will be necessary to remember that the penetrating power of dry heat is very slight, and that packages, bundles, or even articles loosely thrown one upon another, cannot be disinfected in this way.

8. *Sulphur Dioxide* (sulphurous acid gas). Fumigation with burning sulphur has long been a favorite method of disinfection. The experience of sanitarians is in favor of its use in yellow fever, small-pox, scarlet fever, diphtheria, and other diseases in which there is reason to believe that the infectious material does not contain spores. The experimental evidence on record[2] shows that under certain conditions it is effective for the destruction of micro-organisms in the absence of spores, but that it is quite impotent for the destruction of these reproductive elements.

The presence of moisture adds greatly to the disinfecting power of this agent. It is freely soluble in water, one volume dissolving fifty volumes of the gas. It is therefore evident that a saturated aqueous solution is fifty times as strong as the pure gas—anhydrous. In aqueous solution, in the proportion of 1 : 2000 by weight, sulphur dioxide kills micrococci in two hours' time.[3] In a gas-tight receptacle it destroys the infecting power of vaccine virus dried upon ivory points, when present in the proportion of one volume per cent., the time of exposure being six hours.[4] The same proportion destroys anthrax bacilli, without spores, from the spleen of an animal recently dead, dried upon silk threads, in thirty minutes (Koch). These facts show that sulphur dioxide is a valuable disinfectant; but the conditions of successful disinfection, as established by the experimental evidence, are, that the material to be disinfected shall be freely exposed to its action for a considerable time, *in a receptacle which does not permit the gas to escape.* It must be remembered that disinfection of a thin layer of vaccine virus upon an ivory point, or of anthrax blood upon a silk thread, exposed in a gas-tight receptacle, cannot be taken as evidence that thicker layers of infectious material, attached to the surface of bedding and clothing, or enclosed in folded blankets, bundles of clothing, matresses, etc., can be disinfected by the same amount of sulphur dioxide generated in a room which is not gas-tight. It has been shown, by carefully conducted experiments,[5] that the escape of

[1] See *Medical News*, March 14, p. 283.

[2] See Preum. Rep., No. VII, *The Med. News*, March 28, p. 343.

[3] l. c., p. 348.

[4] l. c., p. 344.

[5] l. c., p. 347.

sulphurous acid gas from a bed-chamber or hospital ward is very rapid, in spite of the usual precautions for stopping up crevices when such a room is to be fumigated; and infectious material, enclosed in bundles or protected by folds of blankets, etc., may escape disinfection, after having been exposed for many hours in a tightly closed chamber containing ten volumes per cent. of this gas.

9. Carbolic Acid. The disinfecting power of carbolic acid has been fixed by experiments upon vaccine virus, and upon various pathogenic organisms. A saturated aqueous solution cannot, however, be relied upon for the destruction of spores; but in the absence of spores it is fatal to micro-organisms in the proportion of two per cent., the time of exposure being two hours. Indeed, less than one per cent. is fatal to several of the species of pathogenic micrococci which have served as test-organisms in the numerous experiments which have been made with this agent.[1] Upon the recommendation of the famous Dr. Koch, the discoverer of the cholera bacillus, the committee on disinfectants, of the International Sanitary Conference of Rome (1885), has given this agent the first place for disinfecting soiled clothing, excreta, etc., in cholera. For excreta it is to be used in five per cent. solution, and for clothing, etc., in two per cent. solution. The experimental evidence upon record indicates that it may be relied upon in this proportion.

10. Sulphate of Copper. This salt has been largely used as a disinfectant in France, and recent experiments show that in the proportion of one per cent. it is a reliable agent for the destruction of micro-organisms, in the absence of spores. It is much below mercuric chloride in germicide power, but is a better deodorant—not a better antiseptic—than the more poisonous salt. When we take into account its efficiency, it is comparatively cheap, and is to be recommended for certain purposes. It may be combined with the more potent germicide, mercuric chloride, in accordance with the formula already given.

11. Chloride of Zinc. Solutions of chloride of zinc are largely used in this country and in Europe for disinfecting purposes. It is an excellent antiseptic and deodorant, but its power to destroy disease germs has been very much over-estimated. It may, however, be relied upon for the destruction of pathogenic organisms, in the absence of spores, in solutions which contain from five to ten per cent. of the salt.

GENERAL DIRECTIONS FOR DISINFECTION.

"In the sick-room we have disease germs at an advantage, for we know where to find them, as well as how to kill them. Having this knowledge, not to apply it would be criminal negligence, for our efforts to restrict the extension of infectious diseases must depend largely upon the proper use of disinfectants in the sick-room."[2]

[1] Prelim. Rep. of Com. on Disinfectants, No. VI, l. c., p. 317.

[2] Prelim. Rep. of Com. on Disinfectants of A. P. H. A.

Disinfection of Excreta, etc. The dejections of patients suffering from an infectious disease should be disinfected before they are thrown into a water-closet or privy vault. This is especially important in cholera, typhoid fever, yellow fever, and other diseases in which there is evidence that the infectious agent is capable of self-multiplication, in suitable pabulum, external to the human body. Vomited matters, and the sputa of patients, with these and other infectious diseases, should also be promptly disinfected. This is especially important in cholera, diphtheria, scarlet fever, whooping-cough, and tuberculosis. It seems advisable, also, to treat the urine of patients sick with an infectious disease with a disinfecting solution.

For the disinfection of excreta, etc., in the sick-room, a solution of chloride of lime is to be recommended. This is an excellent and prompt deodorant, as well as a disinfectant. A quart of the standard solution (No. 1), recommended by the committee on disinfectants, of the American Public Health Association, will suffice for an ordinary liquid discharge in cholera or typhoid fever; but for a copious discharge it will be prudent to use twice this quantity, and for solid fecal matter a stronger solution will be required. As chloride of lime is quite cheap, it will be best to keep on the safe side, and to make the solution for the disinfection of excreta by dissolving eight ounces of chloride of lime in a gallon of water. This solution should be placed in the vessel before it receives the discharge. The material to be disinfected should be well mixed with the disinfecting solution by agitating the vessel, and from thirty minutes to an hour should be allowed for the action of the disinfectant, before the contents are thrown into a water-closet or privy vault.

Standard Solution No. 2, of the committee on disinfectants, which contains two drachms of corrosive sublimate and two drachms of permanganate of potash to the gallon of water, if used freely—one quart for each dejection—and left in contact with the material to be disinfected for at least four hours, is a reliable disinfectant *for liquid discharges*. The caution with reference to lead pipes must be remembered, and if this solution is used in the sick-room or in hospital wards, it will be desirable to have receptacles of wood or earthern ware for the disinfected material, which may be carried away and emptied in a suitable locality once in twenty-four hours.

The blue solution heretofore suggested would also be suitable for use in the same way, and with the same precautions. It contains four ounces of corrosive sublimate and a pound of sulphate of copper to the gallon of water. This concentrated solution should be diluted in the proportion of eight ounces to the gallon of water, and the diluted solution used as heretofore recommended—at least a quart for each dejection, and four hours' time. The disinfecting power of the copper salt adds to the value of this solution, and the bright blue color of the concentrated solution leaves nothing to be desired in the way of a color protection against accidental poisoning.

For the disinfection of the discharges of cholera patients, a five per

cent. solution of carbolic acid may be used, in accordance with the recommendation of the International Sanitary Conference of Rome. The time necessary to insure disinfection is fixed at four hours.

Chloride of zinc in ten per cent. solution may be used for the dejections of cholera patients, the same conditions being observed in regard to quantity and time of exposure as were fixed for the other metallic salts named.

It will be best to burn cloths used to wipe away the discharges of the sick, and especially those used in wiping away the infectious material from the mouth and nostrils of patients with diphtheria or scarlet fever. Bits of old muslin may be used for this purpose, and should at once be thrown upon an open fire or gas stove arranged in the fire-place for this purpose.

Infected sputum may be discharged directly into a cup half full of the solution of chloride of lime recommended for excreta, or of Labarraque's solution.

Handkerchiefs, napkins, and towels used in wiping away infectious discharges, if worth preserving, should be at once immersed in one of the following solutions: Chloride of lime, 2 per cent.; carbolic acid, 2 per cent.; mercuric chloride, 0.1 per cent. (=1 : 1000).

The blue solution (containing sulphate of copper), diluted in the proportion of four ounces to the gallon of water, may also be used for this purpose. Cloths used for washing the general surface of the body should also be disinfected with one of the above mentioned solutions; and attendants should invariably disinfect their hands by washing them in one of these solutions, when they have been soiled by the discharges of the sick.

Disinfection of the Person. Labarraque's solution, diluted with twenty parts of water, is a suitable disinfecting solution for bathing the entire surface of the body of the sick, of convalescents, or of those whose duties take them into the sick-room; or a 1 per cent. solution of chloride of lime, or a 2 per cent. solution of carbolic acid, may be used.

The International Sanitary Conference of Rome gives the following directions with reference to the disinfection of the body after death from cholera:

"The body should be enveloped in a sheet saturated with one of the strong disinfecting solutions,[1] without previous washing, and should at once be placed in a coffin."

We see no objection to washing the body, if the strong solution of chloride of lime is used for this purpose. Washing with water would necessitate the careful disinfection of the water and cloths used for this purpose, and of the hands of the attendants. As the odor of chlorine or of carbolic acid would be objectionable under certain circumstances, we see no good reason for insisting upon the use of these agents, rather than on the odorless solution of mercuric chloride, which, in the proportion of 1 : 1000, would no doubt be equally effective. But when there is an

[1] Chloride of lime 4 per cent., or carbolic acid 5 per cent.

odor of decomposition to be neutralized, the solution of chloride of lime will have a decided advantage on account of its deodorizing properties.

Disinfection of Clothing and Bedding. The cheapest and best way of disinfecting clothing and bedding, which is not injured by the ordinary operations of the laundry, is to immerse it in boiling water for half an hour or longer. It should be placed in boiling water as soon as removed from the person or the bed of the sick, and if it is necessary to remove the articles from the room in order to accomplish this, they should be wrapped in a sheet or towel thoroughly saturated with a disinfecting solution. If it is impracticable to disinfect such infected clothing and bedding *immediately* by boiling, it will be necessary to immerse it in one of the following disinfecting solutions, in which it should be left for four hours: Mercuric chloride, 1 : 2000; or the "blue solution" of this salt and sulphate of copper, diluted by adding two fluid ounces of the concentrated solution to a gallon of water; or a 2 per cent. solution of carbolic acid. The solution of chlorinated lime (2 per cent.) may also be used, but we give the precedence to the first mentioned solutions, because of the bleaching properties of this solution. The blue solution does not injure clothing, and is to be preferred for domestic use to a simple solution of corrosive sublimate, which in the concentrated form is highly poisonous, and without odor or color. When diluted as directed, this solution may, however, be used without danger either from absorption through the hands, or by drinking. The metallic taste of the diluted solution could scarcely fail to prevent a fatal dose from being swallowed accidentally.

For outer clothing, and other articles which would be seriously injured by immersion in boiling water, the best disinfectant is *steam*. Exposure to steam at 100° C. (212° Fahr.) for half an hour would be equivalent to exposure in boiling water for the same time, if the clothing is hung up in such a manner as to be fairly brought under the action of the disinfecting agent. To be certain that the steam does not fall below this temperature in the disinfection chamber, a thermometer must be placed in a corner of the room, at a distance from the point of entrance of the steam, or in an aperture from which the steam escapes. This should mark at least 100° C. for half an hour before the disinfection can be considered complete.[1] To accomplish this, it is evident that the steam must come from the generator at a higher temperature, or, in other words, must be under pressure.

It must be remembered that the destruction of spores is the most difficult test of disinfecting power known, and one which excludes the use of carbolic acid, sulphur dioxide, and other agents which enjoy the confidence of sanitarians, and which have been proved by laboratory experiments to destroy pathogenic organisms in the absence of spores. There is good reason for the belief that *dry heat* and *sulphurous acid gas* may be safely substituted for steam for the disinfection of the clothing of patients with cholera, yellow fever, and small-pox, and probably in several

[1] The committee on disinfectants of the International Sanitary Conference of Rome fixes one hour as the time during which steam should be made to pass over the articles to be disinfected.

other infectious diseases (puerperal fever, erysipelas, diphtheria (?), and scarlet fever (?))

As disinfection by steam will injure certain articles, *dry heat* may be used as a substitute for moist heat, but in this case a temperature of at least 110° C. (230° Fahr.), maintained for two hours, will be required. In the use of dry heat, even greater care is necessary that the articles to be disinfected are freely exposed,—that is, not placed in the oven in bundles, or piled one upon another, but freely suspended in the disinfecting chamber. For it has been shown by carefully conducted experiments that the penetrating power of dry heat is very slight. A properly constructed disinfection oven, such as that of Ransom,[1] will be required if dry heat is to be used.

As the appliances for disinfecting with steam or with dry heat are somewhat expensive, these agents are not likely to supplant, for general use, the time-honored practice of fumigation with sulphurous acid gas. This method of disinfection commends itself because of the cheapness of the material used, and the facility of its application. Sulphur dioxide is a less reliable disinfectant than steam or dry heat, but when the necessary conditions are observed there is no doubt of its utility; and the fact that it does not kill the spores of anthrax and of other bacilli is no reason for rejecting an agent which has been demonstrated by experience to be one of great value, which has been proved by laboratory experiments to be fatal to pathogenic organisms in the absence of spores, and to destroy the infecting power of vaccine virus. But in using this agent the conditions of successful disinfection, which have been established by experiment, should be borne in mind. The room which is to serve as a disinfecting chamber must be very thoroughly closed: every crevice and key-hole should be carefully stopped with cotton, or by fastening paper over it. Even this precaution will not prevent the rapid escape of gas from cracks around doors, windows, etc. It is therefore desirable, when practicable, to use a disinfecting chamber which can be hermetically closed. The articles to be disinfected must be very freely exposed, and should never be thrown into the room in bundles, or piled one upon another. We concur in the recommendations of the committee on disinfectants of the American Public Health Association, as to the amount of sulphur which should be burned, and the method of effecting its complete combustion:

"To secure any result of value, it will be necessary to close the apartment to be disinfected as completely as possible, by stopping all apertures through which gas might escape, and to burn at least three pounds of sulphur for each thousand cubic feet of air-space in the room. To secure complete combustion of the sulphur, it should be placed, in powder or in small fragments, in a shallow iron pan, which should be set upon a couple of bricks in a tub partly filled with water, to guard against fire. The sulphur should be thoroughly moistened with alcohol before igniting it."[2]

[1] *British Medical Journal*, Sept. 6, 1873, p. 274.

[2] Preliminary Report, l. c., p. 427.

Finally, we would remark, that in the absence of suitable appliances for disinfection, and in general when the infected articles are of little value, consumption by fire furnishes the readiest and safest method of disposing of such articles.

For articles of value, such as upholstered furniture, etc., which would be injured by any of the processes heretofore recommended, free exposure to the air (aeration) for three or four weeks is directed by the committee on disinfectants of the International Sanitary Conference of Rome. The same committee directs that "objects made of leather, such as trunks, boots, etc., should be destroyed, or washed several times with one of the weak disinfection solutions,"—carbolic acid 2 per cent., or chloride of lime 1 per cent.

The means heretofore recommended for the disinfection of woollen clothing, blankets, and similar articles will not be sufficient for soiled mattresses. As a rule, they should be opened, and the contents disinfected by steam or by dry heat, with subsequent free aeration, and the cover should be washed in boiling water after treatment with a disinfecting solution.

Disinfection of the Sick-Room. Every effort should be made to prevent a room occupied by patients sick with an infectious disease from becoming infected. Carpets, stuffed furniture, curtains, and other articles difficult to disinfect, should be removed at the outset. Indeed, nothing should be left in the room which is not absolutely required, and all furniture and utensils should be of such a character that they can be readily disinfected by washing with boiling water or with a disinfecting solution. Abundant ventilation and scrupulous cleanliness should be maintained, and a disinfecting solution should always be at hand for washing the floor, or articles in use, the moment they are soiled by infectious discharges. For this purpose a solution of chloride of lime may be used (4 per cent.).

It is impracticable to destroy infectious material in an *occupied* apartment by means of gases or volatile disinfectants, for to be effective these must be used in a degree of concentration which would make the atmosphere of a room quite irrespirable. These agents are therefore useful only as deodorants. They are all more or less offensive to the sick, and will seldom be required, even as deodorants, when proper attention is paid to cleanliness and ventilation.

Daily wiping of all surfaces—floors, walls, and furniture—with a cloth wet with a disinfecting solution, is to be recommended. For this purpose a solution of chloride of lime (2 per cent.), or of carbolic acid (2 per cent.), or of mercuric chloride (1 : 2000), may be used.

By such precautions as have been indicated, the infection of the sick-room may be prevented, especially in those diseases, such as cholera and typhoid fever, in which the infectious agent is not given off in the breath, or from the general surface of the body, of the sick person. In small-pox and in scarlet fever there is greater danger that the infectious agent may remain attached to surfaces in the room; for the atmosphere be-

comes infected with particles given off from the surface of the patient's body.

As already stated, the atmosphere cannot be disinfected while the room is occupied. There is much less reason for disinfecting it when the patient has been removed, and it is much simpler to renew it by throwing open the doors and windows than to attempt to disinfect it. Indeed, there will be no infectious particles to destroy, except such as are dislodged from surfaces, window ledges, etc., where they have settled as dust while the room was occupied; and if the precautions above recommended have been taken, the danger of such reinfection of the atmosphere will be reduced to a minimum.

Disinfection of the vacated room, then, consists in the destruction of all infectious particles which remain attached to surfaces, or lodged in crevices, in interstices of textile fabrics, etc. The object in view may be accomplished by thorough washing with one of the disinfecting solutions heretofore recommended; but most sanitarians think it advisable, first, to fumigate the room with sulphur dioxide. This practice is to be recommended, and the directions given by the committee on disinfectants, already quoted, should be followed (3 lbs. of sulphur to 1,000 cubic feet of air space). At the end of from twelve to twenty-four hours, doors and windows should be opened, and the room freely ventilated. After this fumigation, all surfaces should be washed with a disinfecting solution (chloride of lime 2 per cent., carbolic acid 2 per cent., or mercuric chloride 1 : 1000), and afterwards thoroughly scrubbed with soap and hot water. Plastered walls should be white-washed. The fumigation recommended is especially important in the case of rooms, the walls of which are covered with paper, and in rooms from which curtains, carpets, etc., have not been removed; and under these circumstances it will, as a rule, be advisable to repeat the fumigation a second or even a third time. The process is inexpensive, and the old saying that "Whatever is worth doing at all is worth doing well," applies with especial force to the use of disinfectants. Excessive precaution can do no harm, but the inefficient use of disinfecting agents, which results from indifference, or from ignorance of the precise value of the agents relied upon, may be disastrous.

Disinfection of Privy Vaults, Cesspools, etc. The contents of privy vaults and cesspools should never be allowed to accumulate unduly, or to become offensive. By frequent removal, and by the liberal use of antiseptics, such necessary receptacles of filth should be kept in a sanitary condition. The absorbent deodorants, such as dry earth, or pounded charcoal,—or the chemical deodorants and antiseptics, such as chloride of zinc, sulphate of iron, etc.,—will, under ordinary circumstances, prevent such places from becoming offensive. Disinfection will only be required when it is known, or suspected, that infectious material, such as the dejections of patients with cholera, yellow fever, or typhoid fever, has been thrown into the receptacles, which are especially dangerous, because they already contain pabulum suitable for the development of the germs of

these diseases. Mercuric chloride commends itself especially for the disinfection of such masses of material, because, even if any germs escape immediate destruction, they will fail to multiply in the presence of this potent antiseptic. The chloride of lime solution, on the contrary, is preferable for use in the sick-room, because of the promptness and certainty of its germicide action and its deodorizing power. But it has the disadvantage, where large masses of material are to be disinfected, that it is itself destroyed by contact with organic matter; and that if there is a surplus of infectious material after the disinfecting solution has been neutralized, this will be as potent for mischief as a larger quantity would have been.

Mercuric chloride should be used *in solution*, in the proportion of "one pound for every five hundred pounds—estimated—of fecal matter contained in the vault.[1] All exposed portions of the vault, and the wood-work above it, should be thoroughly washed down with the disinfecting solution."[2]

The subsequent daily use of a smaller quantity of the same solution would ensure the continued disinfection of fresh material thrown into the vault. Or chloride of lime in powder may be freely scattered over the contents after the first disinfection with mercuric chloride. A diluted powder, made by mixing one pound of chloride of lime with nine pounds of plaster of Paris, or of clean, well dried sand, may be used for this purpose. This is more easily spread about, can be used more economically, and is sufficiently strong in chlorine for practical purposes. As chloride of lime is an excellent deodorant as well as a disinfectant, such a powder commends itself for general use in open privy vaults and cesspools, not only during the prevalence of epidemics, but at all times when they give evidence of being in an unsanitary condition.

Hospitals. The directions already given in regard to disinfection of the sick-room and its contents apply as well to hospital wards in which patients with infectious diseases are treated. In addition to this, it will be necessary in hospitals to guard against such infectious diseases as erysipelas, septicæmia, puerperal fever, and hospital gangrene. The antiseptic treatment of wounds, in connection with a proper regard for cleanliness and ventilation, has practically banished these diseases from well regulated hospitals. Of the first importance in effecting this are the precautions now taken with reference to the disinfection of sponges, instruments, the hands of attendants, etc.

Instruments of silver, such as probes and catheters, may be disinfected by passing them through the flame of an alcohol lamp. Instruments of steel, gum catheters, etc., may be disinfected by immersion in a five per cent. solution of carbolic acid, or in a 1 : 1000 solution of mercuric chloride. For instruments and vessels of copper, brass, and tin, boiling

[1] Recent experiments made by the writer make it apparent that the complete sterilization of large masses of fecal matter in privy vaults would be a difficult and expensive undertaking, if not entirely impracticable. It is therefore of prime importance that infectious material should be destroyed before it is thrown into a receptacle of this kind.

[2] Prelim. Rep. of Com. on Disinfectants, l. c.

water, or the carbolic acid solution, may be used. Vessels of porcelain or glass may be disinfected by heat, or by either of the disinfecting solutions mentioned. Sponges should be kept permanently in one of the disinfecting solutions, or, what is better, may be dispensed with entirely for the cleansing of wounds. In place of them, irrigation with a disinfecting solution may be resorted to, or the discharges may be wiped away with some cheap absorbent material which can be burned after having been once used.

Patients in hospitals, with infectious diseases, will of course be kept in isolated wards. Everything which comes from such a ward should be disinfected, and the immediate attendants of the sick should not be allowed to visit other parts of the hospital without first changing their outer clothing for a recently disinfected suit, and washing their hands in a disinfecting solution. When relieved from duty their underclothing should also be disinfected; and they should take a complete bath with one of the weak disinfecting solutions heretofore recommended.

Every hospital should be provided with a steam disinfecting apparatus, or with an oven for disinfection by dry heat.

Disinfection of Water and Articles of Food. The disinfection of drinking-water on a large scale, in reservoirs, wells, etc., is impracticable. But it is a very simple matter to disinfect water which is suspected of being contaminated with the germs of cholera, typhoid fever, or any other disease transmissible in this way. This is readily accomplished by boiling. As already stated, all known disease germs are destroyed by the boiling temperature maintained for half an hour. The importance of this precaution during the prevalence of an epidemic of cholera or of typhoid fever cannot be over-estimated, when the water used for drinking purposes comes from an impure source, or is liable to contamination by the discharges of patients suffering from these diseases. Those articles of food, and especially milk, animal broths, etc., which might serve as pabulum for disease germs, should, during the prevalence of an epidemic, be cooked but a short time before they are eaten. And such food, if put aside for some hours after it has been prepared, should always be again subjected to a boiling temperature shortly before it is served. Food which gives evidence of commencing putrefaction is unfit for use, and in time of epidemics is especially dangerous.

Disinfection of Ships. It should be the aim of a physician attached to a passenger ship, or of the master of a vessel having no physician on board, to prevent the vessel from becoming infected when in an infected port, or when cases of infectious disease occur on board. This is to be accomplished by keeping the ship clean; by disinfecting suspected articles, and especially the soiled clothing of passengers, before they are received on board; by the isolation of cases of infectious disease which occur on board; and by the thorough execution of those measures of disinfection recommended for the sick-room. When a case of cholera or of yellow fever occurs upon a ship at sea, it cannot be taken as evidence that the vessel is infected unless at least five days have elapsed since the

person attacked came on board. For he may have contracted the disease from exposure at the port of departure, or in some other locality on shore. When, however, a longer time than this has elapsed, or when several cases develop in a particular locality on ship-board, either simultaneously or successively, the vessel must be considered infected, unless it is shown that the cases are directly due to the opening of baggage containing infected clothing.

In practice, the sanitary officials at the port of arrival usually treat a vessel as infected if any cases of infectious disease have occurred upon her during the voyage. This is a safe general rule, which should not be departed from unless a considerable time—five to seven days—has elapsed since the cases occurred, and they can be clearly traced to exposure before coming on board. In this case, if the ship is clean and the precautions relating to disinfection and isolation of the sick have been faithfully executed, the health officer may be justified in dispensing with the general measures of disinfection which are required for an infected ship.

These measures do not differ from those heretofore recommended for the disinfection of the sick-room and its contents ; but the special conditions on ship-board, and the great interests at stake, make it essential that the execution of these measures should be in the hands of sanitary experts.

In the disinfection of ships, fumigation with sulphurous acid gas is a measure of prime importance, and is largely practised by those in charge of quarantine establishments. The fact that the ship may be almost hermetically closed, and the escape of gas to a great extent prevented, makes this method of disinfection more trustworthy than in the case of dwellings and hospitals. The further fact, that certain parts of the ship are inaccessible for the application of disinfecting solutions, seems to make the use of a gaseous disinfectant imperative.

Disinfection by means of steam, especially of an iron vessel, would no doubt be a difficult matter on account of the condensation which would occur from contact with the cool walls of the vessel below the water-line. But it will be well to fill the vessel with steam before introducing the sulphur dioxide ; for, as already stated, the disinfecting power of this agent is much greater in presence of moisture. A well equipped quarantine establishment should have an apparatus for generating sulphurous acid gas, and injecting it into vessels, as this is the most expeditious and satisfactory method of fumigating a ship.[1]

An essential part of the disinfection of a ship will consist in the thorough cleansing of the bilge. The International Sanitary Conference of Rome prescribes that the bilge water shall be pumped out and replaced by sea water at least twice at each disinfection of the vessel. This is very well so far as it goes, but we would also recommend that after such cleansing, the potent disinfectant, mercuric chloride, be added

[1] The New Orleans quarantine establishment is provided with an apparatus of this kind, which seems to be well adapted for the purpose. See paper by Dr. Joseph Holt, in the annual report of the A. P. H. A. for 1884.

to the clean sea-water remaining in the bilge in the proportion of one pound to the ton of water—estimated. In the case of ships sailing from ports infected with yellow fever, it would be a wise precaution, after the cleansing of the bilge at the point of departure, to throw the same amount of mercuric chloride, dissolved in salt water, into the bilge, and to add a smaller quantity of the same solution at intervals during the voyage.

Merchandise. Article V, of the Report of the Committee on Disinfectants of the International Sanitary Conference of Rome, says,—

"V. Disinfection of merchandise and of the mails is unnecessary. (Steam under pressure is the only reliable agent for the disinfection of rags,—*les chiffons en gros.*)"

We think this statement too broad, especially so far as merchandise is concerned which has been on board a ship infected with yellow fever. The poison of this disease seems to be capable of self-multiplication on a foul ship in tropical latitudes, quite independently of passengers and crew. And there is ample evidence that even when no case has occurred on an infected ship at sea, those who are engaged in discharging her cargo after her arrival in port may be seized with yellow fever from breathing the infected atmosphere of the hold. Evidently merchandise conveyed on such a ship should be disinfected. But it does not seem necessary to break packages which have gone on board in good condition, and a thorough fumigation with sulphurous acid gas will be sufficient if the unbroken packages are so distributed as to be fairly exposed to the action of the disinfecting agent. To accomplish this, and to effectually disinfect the ship, it will be necessary to discharge the cargo at the quarantine station.

The collections of the rag-man cannot properly be placed in the same category with other merchandise, such as agricultural products, hardware, new cotton or woollen goods, etc. An exception with regard to rags is indicated, but not stated with sufficient precision, in the article which we have quoted. There is evidence that small-pox has been not infrequently transmitted by rags, and sanitarians are generally agreed that it would be very imprudent to admit rags collected in or shipped from localities infected with cholera or yellow fever, without first subjecting them to thorough disinfection. The only practical way of accomplishing this seems to be by means of super-heated steam. To make this effective, it will be necessary to open the bales, and spread out the rags in such a manner that they may be freely exposed to the action of the disinfecting agent, or to inject the steam under pressure into the interior of the bale through perforated metal tubes, as is practised at the New York quarantine station.

PART SECOND.

INDIVIDUAL PROPHYLAXIS AGAINST INFECTIOUS DISEASES.

The state establishes quarantine stations, to guard against the introduction of infectious diseases of exotic origin ; and in enlightened countries, sanitary officials, under the direction of the central government, or of states and municipalities, are charged with the duty of guarding the public against such diseases. It is generally recognized that this is to be accomplished by the isolation of the sick, the use of disinfectants, and by general measures of sanitary police.

One way in which the individual may indirectly protect himself against such diseases is by using his influence to have this sanitary service placed in the hands of competent men, and in sustaining them in their efforts to exclude or stamp out infectious diseases by such measures as have been demonstrated by science and experience to be efficient for this purpose.

But this is not the kind of "individual prophylaxis" which we have to consider here. The question is, What can the individual do to protect himself and those immediately dependent upon him, under the various circumstances in which he may be placed, and especially in the presence of an epidemic?

As the advice we have to give will differ greatly according to the disease, we shall pass in review the principal infectious maladies of man, and shall attempt to give for each such practical instructions as will enable an intelligent person to take all practicable precautions for his own protection, and for that of his immediate family. We have first, however, to make some general remarks.

Infectious diseases are contracted by contact with the sick, through the medium of infected articles,—"fomites,"—or by exposure in infected localities.

The evident general rule of prophylaxis is, therefore, to avoid all of these sources of infection ; but there are circumstances in which this is either impossible or unjustifiable. Duty calls the physician and the nurse into the sick-room, and no argument based upon self-protection can keep the devoted mother from the bedside of her sick child, or the wife from giving her personal attention to her husband, or the husband to his wife, when stricken by pestilence. Humanity requires that during an epidemic the sick shall be cared for, the dead buried, and the foul places cleansed. All this calls for the active and intelligent efforts of persons who have the courage to face danger, and not only of those who by their profession are necessarily brought in contact with the sick,—physicians, clergymen, sanitary officials, nurses,—but often, also, of volunteers ; for, during the prevalence of an epidemic of cholera, or of yellow fever, the number of physicians and trained nurses within the infected area is commonly insufficient for the care of the sick.

The history of epidemics shows that brave men and women are to be

found in every civilized country, who are willing to volunteer for such perilous duties ; and also that physicians, and those whose legitimate duty it is to care for the sick, very rarely desert their post in time of danger ; but the mortality among these brave men and women who stand by their guns, and among the volunteers who go to their assistance, is often very great. There is a wide-spread notion among people not familiar with the facts, that doctors enjoy a certain immunity from infectious diseases not possessed by other people, and that the absence of fear is a safeguard against infection. Such a supposition is without foundation, and is an insult to the brave men and women who fall at their post of duty in every epidemic. Courage is no more a protection against disease germs than against bullets. It is true, that in epidemics, as in war, the skulkers and cowards often run into danger which the men in the ranks escape. The rashness which results from ignorance or from thoughtlessness is not courage, any more than the prudence which avoids danger when there is no good reason for facing it is cowardice. Those who rashly venture within the lines drawn by an epidemic, in the pursuit of business or pleasure, on the supposition that they will escape the prevailing disease because they are "not afraid," often fall victims to their unreasoning temerity, and not infrequently beat a hasty retreat, with blanched face, when they are brought directly into the presence of the sick and the dying.

Our advice to the brave is, Do not put your trust in your courage, for it is no armor against infection. Rely rather upon those precautions which science and experience indicate as best suited to the special circumstances in which you may be placed, and do not hesitate to retreat before an invisible foe, when you are not required by considerations of duty to remain upon the field of battle. If your services are not required, you are simply in the way ; and if you fall ill, you add to the labors of those who devote themselves to the care of the sick. And to the timid we would say, Let not your fear control your actions, but look the circumstances fairly in the face, and be guided by reason and knowledge, or by the advice of those competent to decide for you. A premature flight may bring you into ridicule, or into greater dangers than those you flee from. Do not let your fears exaggerate the facts, and weigh these in the balance of your reason, and not of your apprehensions. The fact that Judge A or Col. B has fallen a victim to cholera or yellow fever is no more a reason for deserting your home, than is the fact that the humblest citizen of your town has died from the same disease.

If courage is no protection against infection, it cannot be denied that fear, in the presence of the infectious agent, is a predisposing cause which frequently determines an attack, and which may turn the balance in favor of a fatal result. The depressing effect of fear is well known, and all influences which reduce the vital resisting power of the individual predispose to an attack when an epidemic is prevailing.

Other predisposing causes of a general nature are those conditions of enfeebled resistance which result from ill-health, venereal and bacchanalian excesses, etc.

Of all these, it is probable that excessive indulgence in intoxicating drinks is the most potent factor in swelling the mortality returns during the prevalence of pestilential diseases. This predisposing cause acts in several different ways. The individual whose reason is befuddled by drink, stumbles stupidly into all kinds of danger. He is "not afraid" to sleep upon the ground, exposed to the night air, when yellow fever is prevailing, or to quench his thirst with water which a prudent man would reject as unfit to drink in the presence of cholera, or to wrap himself in a blanket which has recently been in use by a patient with small-pox. Again: the debility, often attended with digestive derangement, which follows a recent debauch, constitutes a most favorable condition for the reception of the germs of cholera, of yellow fever, and of infectious diseases generally. Those who use intoxicating drinks habitually, but within the limits marked by that mental aberration or loss of reason which constitutes intoxication, are less subject to infection than the man who is suffering from the effects of a recent "spree." But if they have any organic disease of the stomach, the kidneys, or the liver, as a result of their habits, this constitutes a predisposition to be attacked, and is a very serious complication when an attack is developed.

Persons suffering from chronic wasting diseases, profuse discharges, or recent hemorrhage, are especially liable to become the victims of an infectious disease during its epidemic prevalence. The same is true of those whose vital resistance is below par from insufficient food, or from the continued respiration of vitiated air, crowd poisoning, sewer-gas poisoning, etc.

In addition to the predisposing causes mentioned, which furnish indications of more or less value with reference to individual prophylaxis, there are individual and race differences in susceptibility to certain diseases manifested by those who are in perfect health. One man may be repeatedly exposed to an infectious disease without falling sick, while another may suffer several attacks of a disease, such as small-pox, in which one attack commonly confers immunity. Race differences in susceptibility are shown in the relative immunity of the negro from the effects of the yellow fever poison, and the great susceptibility of the same race to small-pox.

We shall now consider in detail the question of individual prophylaxis against certain infectious diseases, which, by reason of their fatality and occasional wide-spread epidemic prevalence, seem entitled to special attention in an essay of this nature.

Cholera. In Asiatic cholera the danger of infection from association with the sick, in the capacity of nurse or physician, is very slight. This is amply demonstrated by experience. On the other hand, laundresses, who do not come directly in contact with the sick, but who handle clothing soiled by their discharges, are liable to contract the disease. By far the greater number of cases, however, result from exposure in infected localities, and from drinking infected water. Outside of the area in India where cholera prevails as an endemic disease, localities become infected

and the water-supply contaminated as a result of the introduction of infectious material from previously infected localities, either in fomites, or through the medium of the discharges of the sick. These facts furnish the indications for individual as well as for general measures of prophylaxis.

In the sick-room the precautions to be taken are, to keep the room clean and well ventilated, to disinfect the discharges of the sick and all soiled articles as promptly as possible, and to wash the hands in a disinfecting solution when they have been in contact with the patient or with soiled clothing. Attendants should not take their food in the room occupied by the sick, and should not drink liquids which have been exposed in the sick-room.

The general directions relating to diet, drinking-water, etc., which we shall shortly give, apply to the attendants upon the sick, as well as to those at a distance from them; and it should be remembered, in the interest of the sick, that these attendants do not run any special risks beyond those to which all persons within the area of infection are exposed. Indeed, we may go further, and say that they run far less risk when they are in a well regulated hospital and under intelligent supervision, than do those persons who dwell in the localities outside of the hospital from which the cases under their charge have come.

Attendants upon the sick should have their meals at regular hours, should not be deprived of a fair allowance of sleep, and should never be allowed to become exhausted by protracted vigils or excessive fatigue.

When cholera has been introduced into a country and is extending its limits from day to day, one of the first questions which will present itself to those who are able to change their place of residence will be, whether they shall attempt to keep out of its way, and if so, where it is best to go. The answer to this question must depend very much upon circumstances. Those who are unfortunate enough to live in a city or town which has a bad sanitary record, which is not provided with an efficient health department, or does not provide money to enable the officers appointed to do efficient work, had better decamp in good time, so as to evade the foe entirely, or to meet it upon a field more favorable for defensive operations. There should be no stampede, and no running away in haste, without any definite idea of why and where. The time to go is before the disease has fairly obtained a lodgment. Consider that if the season is not far advanced, and the town is in an unfavorable sanitary condition, there is every reason to anticipate that the first cases will be followed by a severe epidemic, and decide at the outset whether you will put your castle in order to stand a siege, trusting to well considered measures of individual prophylaxis, or whether you will beat a masterly retreat in advance of the first assaults of the enemy. Those who vacillate in the hope one day that the epidemic is on the decline, and in the fear the next that it will sweep everything before it, in the end very often stay, when they could just as well have gone, and at the same time neglect those precautions which they should have taken at the outset if they had decided to stay.

To those who are unable or unwilling to desert their homes, we would say, that when proper precautions are taken the danger is really not very great, and that sanitarians look for the day when cholera will be practically banished from civilized countries. See that your premises are in good sanitary condition, and do what you can to induce your neighbors and the authorities in your town to prepare for the storm. Look especially after the plumbing of your houses, and if there is a cesspool or a privy vault upon your premises, see that it is kept in good condition by the use of antiseptics and deodorants.[1] Above all, be sure that no food comes into your house except such as is sound and good, and that the drinking-water used by your family is beyond suspicion. Well-water is always open to suspicion, and in general, during the prevalence of cholera, it will be advisable to *boil all water used for drinking purposes.* This is a prophylactic measure of prime importance, and there is good reason to believe that if faithfully executed it would, to a great extent, limit the ravages of the Asiatic pestilence. Tea and coffee recently made can be taken with impunity. Milk, during the prevalence of an epidemic, should be boiled before it is used as food. Mineral waters, if bottled at places distant from the infected area, may be drunk in moderation. A moderate amount of sound wine, which was bottled prior to the epidemic, may be permitted to those who are in the habit of using it. Those not in the habit of using stimulants should not resort to their use during the progress of an epidemic. Those accustomed to them should restrict their libations within moderate limits, and will find a little brandy and soda, or Appolinaris water, to be better than wines, and especially than the acid wines, which are apt to derange the digestion.

Food should be plain and well cooked, and should be taken in moderate quantities. Intemperance in eating is quite as bad as intemperance in drinking. Soups, meats, and vegetables should always be served hot, and should not be put aside for a future repast, or, if served a second time, should be brought to the temperature of boiling water shortly before they are eaten. Pastry and rich puddings, and all coarse and indigestible meats and vegetables, are to be avoided. Sound, ripe fruit, which has been brought to the house with the outer skin unbroken, may be eaten in moderation by those who know by experience that it agrees with them. It should be carefully washed before it is eaten. Melons, cucumbers, unripe apples, peaches, or pears, acid fruits generally, and, in short, all those articles which are known to give rise to digestive derangements in the absence of cholera, would better be banished from the supply-list during the prevalence of this disease.

Next to the precautions relating to food and drink, we would place those relating to personal habits and clothing. The bowels should not be allowed to become constipated, and, on the other hand, any tendency to diarrhœa should at once receive attention. This is a matter of the greatest importance, and, indeed, is second to none other in individual prophylaxis. Absolute rest, a light diet, and a dose or two of chloro-

[1] See Part First of this essay for details relating to the use of these agents.

dyne, or of Hope's mixture, or of any approved combination of an opiate and an astringent, will usually suffice to control a slight diarrhœa, even if it is of a choleraic character.

The clothing should be suited to the season, but great care must be taken that it is warm enough at all times to prevent the body from becoming chilled. A broad flannel belt worn about the abdomen is recommended by some physicians of experience, and may be useful. Baths should be taken at frequent intervals, but should not be too prolonged or too cold, and should be followed by a vigorous rubbing of the surface, to establish reaction. Excessive exercise and fatiguing labor of all kinds are to be avoided. One should never feel "done up," as a result of his exertions in the way of business or of pleasure, for the lassitude resulting from over-exertion, like that which results from fear, predisposes to an attack. Mental depression is, so far as possible, to be avoided: grief, despondency, and "carking care" are recognized as predisposing causes in cholera and in other infectious diseases.

The use of "sulphuric acid lemonade"—that is, of pure water acidulated with this acid and sweetened to taste—has been recommended as a prophylactic, and there is some evidence in favor of its usefulness. We would not advise its indiscriminate use, or that of any other prophylactic of this nature. When cholera has made its appearance in a dwelling or in a public institution, the inmates may be given this, to the exclusion of all other drinks.

Yellow Fever. This disease, like cholera, is contracted in infected localities, rather than by contact with the sick. Indeed, it is rarely, if ever, communicated directly by a sick person to his attendants. In infected places the poison seems to be given off from the soil, or from collections of decomposing organic matter, and we have no definite evidence that it is communicated through the medium of food or drinking-water. The history of epidemics of this disease shows that when it obtains a lodgement in a city or town which is in an insanitary condition, in southern latitudes and during the summer months, it extends its area and invades new localities similarly situated, until frost occurs, or at least until the weather becomes comparatively cool in the autumn. Those who remain in an infected area, unless protected by a previous attack, are almost certain to contract the disease, and much less can be done in the way of individual prophylaxis than in cholera. We therefore advise all those who can get out of the way of this fatal disease to do so. As a rule, there will be plenty of time, after there is evidence that the disease has established itself in certain parts of a city, for those who live at a little distance from these centres of infection to get away, in a deliberate and well considered manner. The occurrence of one or more imported cases cannot be taken as evidence that an epidemic will follow, and is no reason for deserting one's home. If proper precautions are taken by the sanitary authorities, it is very probable that no evil result will follow such importation of the disease. But when these imported cases are followed by the occurrence of other cases in the vicinity where they have been sick, or

when such local cases occur in the vicinity of the wharves where vessels from infected ports discharge their cargoes, or in sailors' boarding-houses, etc., it must be taken as evidence that the disease has effected a lodgement, and that infected centres have been established, from which an epidemic will in all probability be developed, if the season is favorable and the city in an insanitary condition.

An epidemic is not developed so rapidly as in the case of cholera, but the disease usually extends its limits in a very deliberate way, and while it is claiming its victims in one section of a city, other sections in the immediate vicinity may be quite healthy. But the territory invaded remains infected until cold weather puts an end to the epidemic. Frequently it happens that no new cases occur in an infected area for several weeks, or even months, for the simple reason that all those who remained to do battle with the pestilence have suffered an attack or are protected by a previous attack. The epidemic has ceased for want of material, but the infection remains, and will manifest itself if unprotected persons venture within the infected area from a mistaken idea that there is no more danger because there are no longer any cases.

In this disease, then, the most important point in individual prophylaxis is to keep away from infected localities, and from those places where the disease is epidemic,—*e. g.*, Havana, Vera Cruz, Rio Janeiro,—during the season of its prevalence. Very many lives have been sacrificed by a misplaced confidence in the protection which courage is supposed to afford against this disease. "I am not afraid," says the merchant whose business calls him to an infected city, or the sea-captain who wishes to obtain a cargo of sugar in Havana during the summer months. But not being afraid does not prevent such persons from being attacked, and the mortality at Havana among sailors from northern latitudes is very great. There is a tendency in places where the disease is endemic to underrate its malignity, and to ascribe every fatal case to some fault on the part of the unfortunate victim or his attendants. He was "frightened to death," or "was not properly nursed," or he was "imprudent," etc., etc. The mortality is no doubt largely influenced by these secondary causes, but yellow fever is a malignant disease, which under the most favorable circumstances is very fatal to unacclimated strangers within the limits of its endemic prevalence, and which in its epidemic extension in new territory claims from 30 to 50 per cent., or even more, of those who fall sick, as its victims. This being the case, we repeat our advice to all those whose duty does not require them to stay on the field of battle, to make an orderly retreat to some place of safety.

The precautions relating to food and to personal habits do not differ materially from those recommended in the case of cholera. The diet should be simple, and excesses should be avoided. Less care will be necessary with reference to the use of fruits and vegetables ;—indeed, they are rather to be recommended, as better suited than animal food to the warm latitudes in which this disease prevails. Constipation should, above all things, be avoided ; and if there is evidence that the functions

of the liver or kidneys are imperfectly performed, suitable medication should be resorted to.

There is no special danger from the use of water, if it is from a source which ensures it from contamination with organic impurities. Spirituous liquors, if used at all, should be taken in great moderation. Nothing is more likely to develop an attack than alcoholic excesses, and the habitual drunkard is almost doomed to death if he falls sick with this disease. Exposure to the direct rays of the sun, excessive fatigue, and venereal excesses are all predisposing causes which it is within the province of individual prophylaxis to avoid. Exposure to the night air, and especially sleeping out of doors near the ground, is recognized by experienced physicians in yellow fever regions as an invitation to an attack. Great care should be taken to avoid chilling of the body, and it is well to sleep as far from the ground as possible. The creoles of Louisiana and of the West Indies generally insist upon closing the windows of a sleeping-room at night.

The mortality among natives of tropical climates, and especially among those whose habits are good, and who are accustomed to a frugal mode of life, is very much less than among the natives of northern latitudes, when these come, without any previous "acclimation," within the influence of the yellow fever poison. Those who are habituated to life in the extreme South enjoy a certain immunity from the effects of the poison, which is shown by a lower death-rate rather than by any exemption from being attacked. One attack of this disease, as a rule, confers immunity from a subsequent attack.

Individual prophylaxis in an infected city will include the avoidance of those localities which give special evidence of being infected, and especial care not to visit such localities at night.

The liberal use of disinfectants in cesspools and water-closets, and a perfect state of sanitary police in and around the premises, will constitute a most important part of the precautionary measures which every individual should take for his own protection and that of his family. A state of mental equilibrium, and an intelligent appreciation of the special circumstances in which he is placed, and of the various measures of prophylaxis heretofore indicated, will enable an individual to look the facts fairly in the face, and to be governed by the light of reason and of science. Unfortunately it too often happens, among the ignorant and degraded, that a spirit of bravado, attended with a neglect of the simplest sanitary precautions, and a disposition to deny the presence of the dreaded foe, prevails during the earlier stages of an epidemic, and that this is followed by a disorderly stampede and a disgraceful neglect of the sick, when the presence and malignant nature of the pestilence are recognized.

Small-Pox. This disease is contracted by exposure to emanations from the body of the sick, or from articles which have been in use by them, or exposed in their vicinity. There is no evidence that the small-pox poison multiplies external to the human body, and the indications for prophylaxis are therefore quite different from those already given for

cholera and yellow fever. One may eat what he pleases, and wallow in filth, when small-pox is prevailing, without contracting the disease, so long as he keeps away from the sick, and is not brought in contact with any article infected by them. In this disease, however, as in the infectious diseases generally, previous personal habits will greatly influence the result when exposure does occur; and the disease is more fatal to the victims of alcoholism, to those who are poorly nourished, and, in general, to those whose vitality is reduced by exposure to noxious effluvia from putrefying material, by living in overcrowded and ill-ventilated apartments, etc.

As it is now the universal practice to isolate small-pox patients as soon as the disease is recognized, the danger of coming, accidentally, in contact with them is not great. There is but little danger of infection from passing within a few yards of a patient with small-pox in the open air, or from passing a building in which cases are under treatment. Unprotected persons who enter the sick-room are, however, extremely liable to contract the disease; and the infectious material given off from the patient's body clings most tenaciously to surfaces, to clothing, etc., and may give rise to an attack after many months, unless destroyed by disinfection.

It is evident, then, that individual prophylaxis will include the avoidance of places which have been occupied by the sick, and of articles used by them, unless there is a certainty that they have been thoroughly disinfected. It is probable that an unprotected person, who feels obliged, for special reasons, to enter the sick-room, may escape infection by the use of an air filter placed over the mouth and nostrils. This should be constructed on the principle of the "Tyndal respirator," in which all inspired air is made to pass through a layer of cotton wadding, which arrests suspended particles. It would be necessary immediately on coming out of the room to burn the cotton filter, to bathe the hands and face in a disinfecting solution, and to change the outer clothing.

It is a general rule in regard to infectious diseases that those who are necessarily exposed to them should take the precaution of not going into the sick-room with an "empty stomach," or in a condition of exhaustion from any cause. A cup of coffee, or a glass of wine and a cracker, may be taken if a considerable interval has elapsed since the last regular meal.

It is well known that against small-pox we have a special measure of prophylaxis, which has restricted the ravages of this disease within the limits which are left to it by carelessness in regard to the application of this measure, or ignorance of its value. Since the famous discovery by Jenner, vaccination has become the prophylactic *par excellence.*

The immunity conferred by vaccination is, as a rule, complete; but there are exceptions to this rule, and vaccinated persons occasionally suffer from a modified form of the disease. The statistics of the London small-pox hospital show that the mortality among unvaccinated persons received into that hospital with small-pox, is 35.55 per cent.; while the mortality among vaccinated persons is less than 7 per cent. No doubt a large portion of the cases of post-vaccinal small-pox might have been prevented by revaccination.

It is now recognized that the protective influence of vaccination is not always of a permanent character, and children who have been successfully vaccinated in infancy should be revaccinated when they reach the age of puberty, or sooner, if small-pox is prevailing in the neighborhood. The operation is so trifling that it is customary to vaccinate old and young, with the exception of those who have been successfully vaccinated within a year or two, whenever an outbreak of small-pox occurs. This practice is to be recommended, but when the operation has been performed in a proper manner, with virus which is known to be reliable, it is folly to insist upon a frequent repetition of the vaccination, because "it didn't take." If the first vaccination has been completely successful, a *perfect* result from revaccination is not usually obtained; and the fact that no result is obtained must be taken as evidence that the person is protected. The prophylactic value of vaccination practised after exposure to small-pox has been demonstrated, and one who is not entirely certain that he is protected by a recent successful vaccination will do well to resort to this important prophylactic measure at once, if he has reason to suspect that he has been exposed to small-pox.

Scarlet Fever. In this disease, as in small-pox, the poison is given off from the bodies of the sick, and is not reproduced independently of them. As we have no knowledge of any means of protection corresponding with vaccination, prophylaxis consists solely in keeping out of the reach of infection by the sick, or by articles infected by them.

The sick person may communicate the disease during the whole period of his illness and convalescence,—a period which often extends to five or six weeks, or even longer than this. Infected clothing, which has been packed away for months, may communicate the disease; and there are numerous instances on record of its transmission to children at a distance from the sick, by healthy persons who have recently come in contact with scarlet fever patients. The lower animals, and especially pet cats and dogs which may have visited the sick-room unnoticed, or which are thoughtlessly given to convalescent children for their amusement, constitute a great source of danger. Persons who have suffered an attack of the disease, or who have but little susceptibility to it, may have a slight sore throat as a result of exposure to the scarlet fever poison, and may communicate the disease in its more severe form to unprotected children. One great difficulty in arresting the progress of an epidemic by isolation of the sick and disinfection, results from the fact that these slight and often unrecognized cases are frequently allowed full liberty.

Infection has been traced to milk which had been standing in the sick-room, or to the same liquid which had become infected at a dairy where scarlet fever had prevailed, and where recent convalescents were permitted to milk the cows.

All of these facts point to a most rigid exclusion of susceptible children from every possible source of infection. The susceptibility of adults is very much less, and, when attacked, they usually have the disease in a mild form. But their responsibility extends far beyond the point of

avoiding the sick for their own protection. Those who are associated with susceptible children have no right under any circumstances to visit the room of a scarlet fever patient without taking the most thorough precautions with regard to the disinfection of their person and clothing immediately upon leaving it; and even with these precautions, such a visit cannot be justified when it is made simply out of curiosity or friendship. Only those who are in attendance upon the sick should be allowed in the sick-room, and they must be regarded as infected persons, who are not to be permitted to come in contact with unprotected children while they are engaged in this duty.

Diphtheria. This is a disease in which the infectious material is given off from the surfaces affected, and probably not from the general surface of the body. As the usual seat of the disease is the throat and the nasal mucous membrane, it is the discharges from these surfaces which are especially dangerous. Although adults are much less susceptible to the disease than children, there have been numerous instances in which they have contracted diphtheria by the accidental reception of a bit of infectious material directly into the fauces. This is especially liable to occur during the operation of tracheotomy; and several physicians have lost their lives in this way, in their efforts to save those of their patients by aspirating through the tracheotomy tube. It seems extremely probable that the diphtheretic poison—germ—is capable of increase, independently of the sick, in damp, foul places, such as sewers, damp cellars, and especially under old houses in which the floors come near the surface of the ground, leaving a damp, ill-ventilated space. At all events, the disease often clings to such houses in spite of the application of the usual means of disinfection. There is no doubt as to the influence of bad hygienic conditions in maintaining the infection when the disease has been introduced, and it is possible that such conditions may, in certain cases, originate it.

Insufficient nourishment, the malarial poison, and insanitary surroundings are predisposing causes to the disease. Those suffering from scarlet fever, measles, whooping-cough, and tuberculosis are also especially liable to be attacked. As in the case of scarlet fever, mild cases, which in the absence of others more pronounced it would be difficult to recognize as due to the diphtheretic poison, may give rise to malignant diphtheria in more susceptible individuals, or in those whose vital resisting power is reduced by any of the causes mentioned.

Prophylaxis will demand complete non-intercourse with the sick, avoidance of infected localities, and care to exclude all persons and articles coming from such houses from contact with yourself or children. The disease is often spread by thoughtless persons who visit the sick-room, and even kiss the infected patients, and then, without any precautions in the way of disinfection, fondle healthy children in other places, and perhaps transmit by a kiss the infectious material which has adhered to their lips. The possibility of transmission by pet animals is also to be borne in mind.

Tuberculosis. Recent researches have demonstrated that tubercular consumption is an infectious disease, and that the sputa of those affected with it, injected into susceptible animals, reproduces in them the same disease. This sputum is therefore infectious material, and should be destroyed by burning, or by the use of chemical disinfectants. There would be little danger of infection from the moist masses of sputum, but in a desiccated condition this material is liable to reach the lungs of susceptible individuals, and to induce the disease.

It is well known that there is a great difference in susceptibility to pulmonary consumption, and that in certain families this disease carries off one member after another, while it is unknown in other families. Those who have this hereditary predisposition should pay special attention to individual prophylaxis. They should avoid intimate association with consumptive persons, should live under the best hygienic conditions, in dry, well ventilated apartments, and should select an occupation which will keep them in the open air, rather than one which keeps them confined to the house. Above all, they should avoid the respiration of an atmosphere loaded with organic impurities, or with irritating inorganic particles—dust of various kinds. Out of door life on the high and dry plains in the centre of the continent, or in the mountains, will in most instances enable them to overcome the predisposition, if commenced before infection and the resulting tubercular lesions have occurred.

Those who are engaged in occupations which require them to pass some hours each day in an atmosphere loaded with dust will do well to wear a respirator for filtering the suspended particles from the air; for it is demonstrated that, independently of hereditary predisposition, the respiration of such an atmosphere predisposes to tubercular disease of the lungs.

Typhoid Fever. In this disease, as in cholera, the infectious agent is contained in the alvine discharges of the sick. In the interest of self-preservation as well as in that of the public good, every individual who has charge of cases should see that the evacuations from the bowels are thoroughly disinfected before they are thrown out.

The drinking of water contaminated with such infectious discharges is recognized as a very frequent mode of infection; and individual prophylaxis demands an intelligent consideration of the source from which a supply of drinking-water is obtained for personal or family use. If there is the least reason to suspect that this supply may be contaminated by typhoid material, or if it contains an undue amount of organic impurities, it should be rejected entirely, or boiled shortly before it is used.

Typhoid epidemics have in several instances been traced to using milk which had been contaminated by infected water, added to it directly, or used at the dairy to wash the vessels containing it. The remedy in this case is to verify the purity of the source of supply of all milk used for drinking, or to boil it immediately before it is used.

The water of wells located within the limits of a city or village should not, as a rule, be used for drinking purposes, for the soil is almost cer-

tain to be polluted; and it often occurs that the contents of privy vaults and cesspools pass into the same porous stratum of sand or gravel from which the well-water is obtained, or that surface drainage finds its way into shallow wells. It will be necessary, also, to regard with suspicion the water of small streams and ponds which are so situated that they may receive the drainage from collections of filth upon their margin.

Next to impure water we must place impure air as a factor in the etiology of typhoid fever. There is good reason to believe that the germs of the disease may be carried by the foul gases which are given off from sewers, privies, etc., when these become infected, and that the disease may be induced by the respiration of such a contaminated atmosphere. At all events, the breathing of a vitiated atmosphere, and insanitary surroundings generally, constitute predisposing causes which should be avoided.

In typhoid fever, as in yellow fever and cholera, depressing mental emotions, such as grief, despondency, or fear, and physical exhaustion from excessive fatigue, insufficient food, etc., are predisposing causes which may induce an attack in the presence of the infectious agent.

Concluding remarks. This chapter might be greatly extended, but, having passed in review the principal measures of individual prophylaxis against those infectious diseases which are most fatal, we shall not dwell upon precautions to be taken in other contagious diseases, such as measles and whooping-cough. These precautions will not differ from those already recommended in the cases of small-pox and scarlet fever. So, too, in regard to the infectious skin diseases. These are communicated by personal contact, and rarely occur except among those who neglect personal cleanliness, as well as other sanitary laws. Soap and water will generally suffice for individual prophylaxis. By avoiding filthy persons as well as filthy places, the danger of contracting these and certain other unmentionable infectious diseases will be reduced to a minimum.

THE PREVENTABLE CAUSES OF DISEASE, INJURY, AND DEATH IN AMERICAN MANUFACTORIES AND WORKSHOPS, AND THE BEST MEANS AND APPLIANCES FOR PREVENTING AND AVOIDING THEM.

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THE PREVENTABLE CAUSES OF DISEASE, INJURY, AND DEATH IN AMERICAN MANUFACTORIES AND WORKSHOPS, AND THE BEST MEANS AND APPLIANCES FOR PREVENTING AND AVOIDING THEM.

We are aware that the home life of the average American mechanic is not what it should be. In considering our subject, we must assume that he comes from a clean house, well ventilated; that he has a pure water-supply; that he brings a well nourished body; that his clothes are clean, and duly cared for;—in fact, his wife's work "should praise her in the gates."

The location of the factory is an important subject for the workman. In the city he is exposed to lung disease from a smoky atmosphere and impure air, bad eyes from poor light during the day-time, great danger from fire owing to the buildings' being huddled together, and also from the combustible nature of the surroundings. The suburban factory presents disease in the shape of malaria and pulmonary troubles, owing to the fog that rises from the undrained land, and from fevers from the bad or no sewer connection.

Unfortunately the builders of factories have not that latitude of choice open to builders of private residences. The manufacturer has many limitations, such as water-power, and proximity to railroads and other factories. Some, of strict necessity, must be carried on in the midst of thickly settled cities. Manufacturers are, however, each year loosening the fetters that seemingly have bound them, and are exercising more thoughtful care in the selection of building sites. They find it profitable to their pockets, as well as contributory to the health of their operatives, to erect their buildings in moderate sized towns, or in the suburbs, rather than in the heart of the great cities themselves.

The building should be placed upon well drained land, and every precaution should be taken against any possible trouble from surface or overflow water. These remarks apply also to the adjoining lands, as land that fluctuates from overflow to dry soil is a frequent cause of malaria.

The building should be of brick, and, if possible, only two stories high. (A woollen manufacturer, who had the experience of several fires in his factory, remarked in our presence "that were he to rebuild, he would only build two stories high, as then, in case of fire, the hands would feel certain of their safety, and make a stubborn fight to subdue the flames.") The floor timbers should rest on ledges built in the walls. The flooring should fit closely, affording no hiding-places for rats. Where noisy occupations are to be carried on, the floors are to be "deafened." Each story

is to be high enough to permit of good ventilation without the draft striking on the heads of the workmen ; the roof to be of metal or slate ; stone coping to be used on chimneys and all walls extending above the roof: this prevents loose bricks from falling. The cornices should be of sheet metal, when stone, brick, or terra cotta is not used ; columns to be of hard wood or brick, as they will not warp if badly heated ; chimneys to rest upon their own foundations, starting from the ground ; the walls to be whitewashed directly upon the bricks. If plastering is required, use metallic lathing. The stairs, of easy pitch, are located at each end of the building. In long buildings other flights are to be added, so that no person will be obliged to go over eighty feet to reach a stairway ; the stairs to be of iron, excepting the treads and risers, which may be of wood. Where women are not employed, omit the risers ; each flight to reach the story above by a direct flight, no turns to be permitted ; the top of each flight to be cased in, and a door provided which is to be closed each night, and after the exit of the operatives in case of fire. This door is to be of plank completely covered with tin, the joints of which are turned over. The hinges to the door are to be fastened by bolts passing clear through the door. This style of door is the proper one for inside purposes where one section of the building is divided from the others. This door will stand where the ordinary iron door would be curled up and drawn out of position by the heat. A scuttle fastened only by a hasp is to be placed in the roof over each stairway. This scuttle is reached by a flight of steps always in position. Elevators and elevator shafts are the causes of many accidents. At the best they are dangerous things, and need to be carefully guarded. The shaft forms a direct means of communication for the flames from the basement upwards ; it is ever ready for the reception of any thoughtless person. The moving cage or platform crushes and maims, and the parted rope sends its precious load to the bottom of the elevator well, a mangled mass of humanity. The elevator should have safety self-locking attachments (to operate in case of a broken suspension rope), self-closing hatchways, and guards at each landing. One person should be designated to run each elevator, and he should be held strictly responsible for its proper use. Thus, detailing one person for this duty is entirely practicable, even when the elevator work is not enough to occupy his time. By a system of gong signals, he can be called from his other work to run the elevator when required. A good sized gong-bell is located in the elevator well, and strokes call as follows : One, basement ; two, second floor ; three, third floor ; four, fourth floor ; a clanging of several strokes, an emergency call. We have seen this plan most satisfactorily carried out for several years. If self-closing hatchways are not adopted, a sign marked DANGER should be suspended by cords or chains about five feet from the bottom of the elevator : this gives timely warning to those below of the descent of the elevator. Where there are projecting cross timbers in the elevator well, their corners should be rounded, in order that nothing may be caught under them. All elevators should be provided with automatic shifting

devices, to operate in case the carriage, from any cause, is left running. Ropes and chain falls should have a shifting lever attached to the beam, to be operated by a projection just above the hook. This runs the driving belt upon a loose pulley in case the winding drum is permitted to go too far. Proprietors should insist that all elevator operators, and all who ride upon *freight* elevators, maintain the standing posture, as then they are in position to use all their faculties in case of accident. It should, if possible, be a rule, upon all freight elevators, that only the operator ride. Many accidents are the direct result of "fooling" upon the slow freight elevators, where all are allowed to ride. In a factory with which we are acquainted, they have a very slow freight elevator, taking some two minutes to cover five stories. One warm day, the operator, having to go empty from the basement to the top store room, laid down upon the elevator platform. His head by some means came in contact with a timber: he would have been killed had not his cries quickly attracted the attention of one of the foremen, who stopped the elevator. As it was, his scalp hung over his face, being held only by a hinge at the forehead. Had he been standing upright, the accident could not have happened.

The annual loss of life in attempting to escape from burning factories is appalling, and the subject of fire-escapes demands the most serious consideration. Fire-escapes are of many forms. The best ones for general use, and the only kind that can be relied upon where women are employed, is the zig-zag iron stair system of ladders with *flat* treads, the whole to be of iron firmly secured to the outside of the building, and extending to the roof. Women are extremely sensitive about making any seeming exposure of their limbs;—this fact, coupled with the confusion incident to fires, has, in the opinion of experienced persons, rendered the ordinary perpendicular ladder next to useless. With the flat treads the ladders are converted, practically, into steps; the inclination is easy, and an uninjured woman or child may descend in perfect safety, and without fear. This style of fire-escape enables a sound person to assist or bring down an injured or unconscious one.

In locating the ladders, select a side of the building that may be safely covered by the hosemen standing on the ground. Do not bring the ladders near the windows of rooms containing extra inflammable material, as by so doing the exit may be cut off in case of fire. For high factories, where men alone are employed, a good supplementary escape is one of the endless chain pattern, the rate of descent being graduated and controlled by an escapement or friction governor. These escapes permit a continuous line of persons to escape, as several may be upon the descending chain at a time. This style of fire-escape presupposes a strong pair of uninjured arms and hands, and full possession of the mental faculties. Another pattern of escape is where a belt encircles the body, and has a frictional device through which the rope plays, one end of which is attached to the window frame. We have seen a man descend one hundred feet by this means. This style of escape can have only a partial approval.

The simplest of all escapes is a rope long enough to reach the ground, and attached to the inside of each window sill,—the rope, in loose coils, hanging upon a hook or pin, ready to be thrown out in case of danger. This simple rope escape is good for many purpospe, but cannot be regarded as a safe escape, as an injured person could not descend.

Where there is danger from sudden explosions or fire, and the building is not over three stories high, the "sliding poles," such as are common in the fire department houses, may be used. They afford a quick means of reaching the ground with comparative safety. Connected with the factory office there should be a system of electric bells and speaking tubes. In our factory they enter the telephone room at the office. At first we had several tubes, but we have found one general tube to be more satisfactory. At the office end, clustered around the mouth of the speaking tube, are the push-buttons for the electric bells calling the foremen. The foremen, in turn, have a button calling the main office; also one for each of the other foremen. By stepping to the tube and operating the buttons, one can speak with any or all of the foremen. The advantages of this system, in case of fire or other emergency, are apparent without further comment.

The escaping gas and odors from the water-closets are a fruitful cause of disease. The water-closets should all have a good "wash," and be trapped under the seat; and another trap should be added to the pipe as it nears the sewer. The closets of ordinary construction for the women should open from a commodious room, which is to be used as a dressing room. The closet for the men should be provided with a lifting sub-cover, thus adapting it for either a water-closet or urinal. This suggestion may be objected to by some, but observation has convinced us that the combined affair is less offensive than the separate system. For if the pans have the ventilating tubes connecting with the ventilating shafts, as is now common in all good plumbing, the constant wash of the pan will prevent all objectionable odors. The seats, pans, and pipes are to rest upon iron supports. The seats are to be of hard wood, well filled; no wood-work at the front. The floor should slope gently towards the front, and be covered with zinc nailed off with round-headed zinc nails, into squares of two or three inches on a side. This arrangement permits the free use of the mop in cleaning, and suggests a clean place with but little trouble. Many prefer the automatic operating valves, but we prefer the common method of handle and chain, as then any required amount of water may be used. If urinals are used, keep a piece of carbolic soap in each, and flush them often. All sinks and wash-bowls should be trapped. Have all the pipes in sight, and accessible. Where chemicals are poured down the sinks, use cesspools covers. These are circular pieces of wood covered on the under side with lead and rubber, and having an earthen knob on top. Ventilation should be such that a change of air is effected without drafts upon the head of any person. This may be accomplished by placing the top openings, whether into air shafts or to the outside, well up, and by keeping the inlet openings well down. Some

years ago the writer served as a junior member upon a hall committee to overlook the construction of a hall devoted to social meetings. We had all suffered in the old hall from bad air and drafts of air, although the building was supposed to have an elaborate ventilating system. In our new hall we brought the hot air register to the centre of the hall. In the wall of the building was placed a register connecting with an air chute, which also opened about the centre of the hall. Half round windows, opening downward, were placed near the ceiling. By manipulating the openings according to circumstances, a comfortable, well ventilated hall was secured at any season of the year. A bald-headed person could sit under any of the open windows in this hall, and not take cold. We believe that the drafts from the ordinary windows cause much sickness, and that the time will come when our advanced builders will imitate the best car builders, and have most of the windows tight, depending upon special appliances for ventilation. In all cases see that the new air is *pure air*. Drafts of air cause much trouble in every factory of which we have intimate knowledge. Many of these cases may be easily overcome. Probably persons do not differ as widely upon other physical conditions as upon exposure to currents of air. One man may work unaffected in a strong draft, to which his seemingly more robust shopmate would take exceptions. In those portions of the country where lung troubles and catarrh are common, great care is required. The sensitive workman should be permitted, so far as possible, to select his location. Paper caps, having two ventilating holes, are useful in many cases.

An important contributor to health is the sunlight. The difference between a well and ill lighted factory may be practically illustrated in every large city where houses, that once were healthy homes, are now sickly ones,—the cause being directly traced to the shutting off of the sun's light by high buildings being erected near them. For fine work, where the eyes are constantly used, a north light is best, the workman sitting so he receives the light directly in front or at the left hand. This will not shade the work while using the right hand. An opposite wall is improved by giving it a coat of whitewash; this also gives a good background against which to sight work while testing it. An awning to each window, although expensive, is the best summer protection we have seen. The portions of a building most often neglected as to light are the hallways and stairways, and this neglect has produced many accidents.

"Double windows" are a protection in winter for exposed locations. When used, one light should be hinged for ventilating purposes.

We think the subject of lightning-rods requires no further consideration than that they be good ones, and put up in accordance with well known laws of safety. Do not place iron articles against them, as they may lead the lightning in a dangerous direction. The electricity reaching the ground during a thunder-storm is greater than many suppose, as the rain-water conductors carry down considerable. A friend of ours re-

ceived a severe shock while adjusting a disarranged spout. If the roof has any considerable pitch it should be provided with fenders, to break up and hold the snow and ice, thus preventing the too often disastrous slides. Special pains should also be taken as to the steps. See that the drip from the roof or porch does not fall upon them, and, freezing, make an icy covering. The steps, if of metal or stone, should, in a northern latitude, have a wooden covering in winter. Use sand upon the sidewalks and steps during an icy time. The weight of the snow itself is often dangerous, even in the case of well constructed buildings, but it becomes more dangerous, owing to its increased weight, when saturated with water after a heavy rain-fall. In clearing the snow from the roof, see that the space where it is thrown is properly roped off and guarded.

From our own experience we are fully impressed as to danger from fire; and while we have alluded to the subject in other portions of this article, there are several matters that require detailed consideration.

The heating of the building is best done by means of steam-pipes surrounding the rooms. The pipes should be supported by iron brackets; and in no case are the pipes to come near wood-work, as fires have originated from this cause, the assertions of some ill-informed persons to the contrary notwithstanding. Where stoves are used they should stand in iron base-pieces, the edges of which are turned upward some two or three inches: this prevents sparks and loose particles of coal from falling on the floor. See that the stove-pipes are securely fastened by wires to the ceiling and chimney: that the pipe enters the brick-work flush with the flue; and if the pipe is carried through a partition, see that the thimble keeps the pipe well away from the wood-work. Keep the tops of stove and steam-pipe clear of sawdust and dirt, and pile nothing that will drip or fall against them. In burning sweepings containing sawdust, do not crowd the fire too much with the door closed, as cases are known where the flames have, with an explosion, burst from the door when opened to put in a fresh supply. One person should, in each room, be directly responsible for the care of steam-pipes or stoves, and the ventilation. The temperature that will probably be the most acceptable to the majority of persons is from 68° to 72°. The lights in each room should be under the care of one person: this prevents a general use of matches. Gas-lighting should be done with the electric hand-torch, unless all the burners are connected with a system of electric wires igniting all at once. The gas should be shut off during the day, and after the building is vacated for the night, to prevent the leakage, that is always greater or less where the piping is extensive. In case of a fire happening when the gas is lighted, shut it off as soon as the building is cleared: this will shut off some fuel from the flames. The office supply may be drawn from a separate meter, or that supply-pipe may tap the main pipe between the shut-off and the meter. Some special provision should be made for the office, as that department requires gas as times when the factory is not running. Secure gas and kerosene fixtures from swinging against the wall or under shelves. Steady all pendent fixtures by means of wires. Place protect-

ors over all lights that come near anything overhead. The writer has attended at least one fire caused by sparks adhering to the soot upon the bottom of a glue-pot; hence the necessity of seeing that the fire is all out where the old-fashioned glue-pots are still in use. We advocate the use of steam glue-pots, not only for their safety, but for their other advantages. Oiled rags, saturated cotton waste, and all combustible waste material should be collected at the close of each day and deposited under the boilers. We know of one large furniture manufactory where several fires had occurred from the rags, saturated with filling, which was of an exceedingly combustible nature. The proprietors, for their own safety, made a change for a less dangerous composition, but at an annual loss of $2,500. In our own experience we have seen a smoking fire from rags that had been saturated with filling only ninety minutes.

Ashes and all waste combustible material not at once put under the boilers should be deposited in riveted or seamed metallic receptacles, having metallic covers, and the whole placed out-doors at a distance from the buildings. The fires resulting from smoking have been so numerous in the past, that now most well regulated factories have notices posted, prohibiting smoking upon the premises. One of the most noted manufacturing establishments in the country, in order to avoid all possibility of danger, prohibits a pipe or a cigar being brought into the factory. The old-fashioned sawdust spittoon has yielded its full quota of fires, but fortunately they have been slumbering ones, breaking out in the dead of night, or on Sundays and holidays: so the loss of life to be attributed to them is small. All spittoons should be of earthen or of metal. If an absorbent is required, use dry earth or ashes, as then, if a match, cigar-stub, or other combustible article is thrown in, no danger follows.

A special fire-proof building, at a distance from other buildings, should be devoted to the oils, turpentine, varnish, and kindred combustible stock, only a day's supply being removed at a time. When the boiler-room is left, even though temporarily, see that the openings under the boiler are closed. We had a fire in our factory, the result of a fifteen minutes absence of the fireman, who left his under door open, also the one into the fuel-room. A brisk spring breeze blew out a line of shavings that formed a pathway for the fire to a bin of very combustible material, and it was only after a stubborn fight that the building was saved. In establishments requiring the use of lenses, see that these articles are not left where they will focus. The writer once had a stereoscopic view destroyed, the instrument holding it being left in a window. Matches should be kept in iron self-closing holders, the stock to be kept in covered tin or earthen vessels. Keep the yards and surroundings free from straw, old cases, and all rubbish. One of the worst fires we ever saw was a second fire catching in some straw by a spark from the original fire, a distance away. Keep the yard well wet down in dry times. If there is a shaving-chute, see that it is tight, and does not drop any dust or shavings till the shaving-bin is reached. This chute is to have a shut-off, which is to be promptly closed upon a fire alarm being given.

A volume might easily be written upon the dangers from naphtha and benzine. Although the temptation is strong to use them, they should be banished from the factory. Where printing-presses are used, substitute turpentine for cleaning off the rolls. Some of the carburetors in the market are very dangerous, from the fact that they use the dangerous products of petroleum, which, leaking through the service-pipes, cause explosions if a fire or light is present. Keep telegraph and telephone poles away from the buildings, as the wires cause the loss of precious minutes to the firemen in raising the ladders.

The system of sprinklers introduced within the past few years affords great protection. Perhaps the best evidence we can produce in their support is the favorable opinion of the underwriters. Briefly, this system consists of pipes extending over the ceilings to the rooms, hall-ways, and stair-ways. These pipes are provided with a sprinkler about every eight feet. Each of these sprinklers is stopped by a cap held in position by fusible solder, melting for ordinary cases at 150° for engine-rooms, or dry-houses at 200°. The water pressure being constant, a wetting down is assured in case of fire. In our factory we have had two occasions to test them. Each time they went off by the heated air or smoke, the live flame not reaching to them. Their work was regarded as most satisfactory. One pattern of the hand-grenade is in our house and in the factory. While these articles, perhaps, add another means of security, too much dependence should not be placed upon them.

The public tests of all this class of extinguishers seem satisfactory, but, from age or other causes, they seem to lose their power. Five of our quart size were thrown at a neighboring fire without checking it. We then ran out our private line of hose and stopped it. The automatic electric fire alarm sounds a bell when the heat reaches a certain point: this makes it an efficient monitor in case of fire. It is of especial value for store-rooms and parts of the building not constantly occupied.

Electric light lines should be well guarded, as fires have resulted from their disarrangement. The wires, unless properly protected, are dangerous to the touch when the electric current is on. Accidents have resulted from the wires' being touched. When the fire is the result of a defective electric light apparatus, use great caution in applying the water, otherwise the person throwing it may be knocked over. Throw the water from the pail so it will leave in a mass. If it forms a continuous stream, a current is established. We can mention one fire from this cause, where two men, in trying to put it out, were repeatedly knocked over, until the cause suggested itself, when they threw the water in masses without further trouble till the current at the central supply was shut off.

The following constitute the fire apparatus outside the building: A hydrant with hose attached: the hose is coiled up and safely "housed" from the weather in a closet erected against the wall. The wrench for turning on the water is also hung up in the closet. The door is simply buttoned: then any one may use the apparatus in an emergency. Against the wall, under a protection from the weather, hang a strong ladder, with

spikes at the bottom end, a scaling-ladder having hooks at its upper end, and a fire-hook. This hook of iron, with a chain attached, is mounted upon a long, stout pole. A rope is attached to the chain. The inside portable fire apparatus, distributed at accessible points, consists of tubs and pails of water, fire-axes, ropes with hooks attached for drawing up hose, and hand fire-grenades (if they can be made to hold their vitality). Have at the foot of each flight of stairs a fire-axe, a lantern filled with sperm or lard oil, and one or more pails of water. The water in the tubs and pails, if in a freezing temperature, is to be saturated with salt. Each workman should have his appointed place for fire duty. All the hose and hydrant couplings should have couplings corresponding with those of the local fire department.

Dust may be classed under two heads,—first, that ordinarily recognized as dust, being a miscellaneous collection of fine particles, containing more or less decaying matter ; and, secondly, the finely disintegrated portions of material thrown off in the mechanical process of manufacturing. The first is easily managed, so an ordinary regard for neatness renders a detailed consideration unnecessary. The steam-pipes are apt too often to be neglected, the very fine dust accumulating being thrown off and mixed with the atmosphere when the steam is suddenly let on. The rooms should be swept after the day's work is done, using moist sawdust for a sprinkling. This keeps the dust down, and the floor will soon dry. Mechanical dust is more difficult to manage. The ordinary wood sawdust is now, in the best regulated factories, conveyed by suction, produced by a fan-wheel, to a bin, or room adjacent to the boiler-room, where it is burned under the boilers, with other refuse. These ducts, while serving an admirable purpose, are also dangerous in case of fire, furnishing a direct communication to the most inflammable portions of the factory, the shut-offs being the only safety. Dust from sanding and polishing machines, which are revolving disks, drums, or reciprocating surfaces covered with sand-paper, may be also withdrawn by the air blast into a bin or receptacle by itself. Black walnut sawdust is particularly offensive to persons of catarrhal tendencies, and needs to be carefully looked after. In case of metals, the dust may be removed from in front of the workman by suction or a blast of air. Persons who have been troubled from metal dust have been enabled to continue their work by growing a moustache, which caught the particles before they could reach the nostrils. In large cities and towns, where the water-supply is drawn from a common source, the water usually is good, but in isolated factories where resource is had to wells, great caution is needed to avoid pollution from drains, manufacturing waste, etc. The ice supply is hardly at all recognized as a source of danger, yet it is important that the ice used come from a clear body of water, and, if not in motion, large enough to furnish clear blocks of ice free from dirt. Do not use ice cut from small ponds, or the inlets of large ones, as these places are usually the dumping-places of dead animals, and other objectionable refuse. The most satisfactory method of cooling water we have seen, is where

the water flows through block-tin pipes encircling the ice chamber. This gives water cold enough for ordinary purposes. Where the work is exhaustive, or the weather excessively hot, we recommend that broken ice be placed in a non-conducting receptacle. A piece of ice the size of a walnut held in the mouth will be refreshing. Before using water or ice, rinse the mouth thoroughly. Evidently many of the so-called prostrations by heat should be attributed to the immoderate use of ice-water. In most manufacturing establishments there is a considerable amount of "handling" the goods in the process of manufacturing, transporting it from one part of the factory to another. This work is generally done by cheap and unskilled hands, and many accidents result from the lack of skill and the proper appliances for doing the work. Where the rooms are on the same level, and the pieces are large and heavy, a track should be laid, the rails of which are even with the floor. Upon this track the platform car is pushed. A differential pulley block and chain raises and lowers the articles holding them at any point. For general factory use we have found the platform trucks to give satisfaction. These trucks are made of a length to be taken upon the freight elevator. They can then be taken up-stairs, down-stairs, run over the connecting bridge between buildings, through doorways, and, in fact, in any portion of the establishment where it is desired to carry goods. This truck is a wooden platform mounted on an iron axle and wheels, with a trail-wheel at each end. It has stakes which are removable. The tops of the wheels are below the surface of the platform. Some accidents result from handling cased goods, because the workmen cannot get hold of them. It is difficult to hold a heavy case with the hook found in the hardware stores, but with a specially constructed hook our shipper claims he can hold as much as two men with the common hooks. Ours has a good point. The back curve is like the ordinary hook. The forward curve does not extend too far out, but enough to give a good leverage on the case or box. The handle or shank portion slightly recedes, and is flattened out so as to fit nicely between the fingers. The length is about double that of ordinary hooks. It is hard work for even a clumsy man to receive a "pinch" while using this hook.

Do not start the engine during the noon hour, or at other times when not expected, without giving due notice, as otherwise there is danger of somebody's being injured if he is cleaning or overhauling the machinery. There should be a complete code of signals for the engine-room, leading from every portion of the factory where machinery is used. The gong used should be of a size to be easily heard in the boiler-room, as then the stoker can shut off the engine if the engineer is temporarily absent. Many distressing accidents happen by persons being caught in the shafting and machinery. The prompt stopping of the engine is of the utmost importance. In too many shops the engineer is also the steam and gas engineer of the establishment, and is more frequently found in the shop than in the engine-room.

Avoid oiling accidents by doing this work out of work hours (when

the shafting is at rest), paying the workman detailed a special price for the constant supervision. The jars and motion communicated to the workmen by machinery and pounding are more injurious than at first supposed. The body absorbs the concussion, and produces a tired feeling upon all but the most robust.

The difference between a well and poorly conducted factory is as great as between riding in a Pullman and a caboose. Great care is needed relating to noise. Workmen on up-stairs floors should be cautioned against jumping from the benches to the floor, or dropping tools or heavy pieces of work. Sheets of thick rubber are used with good results under pounding-blocks, etc., to absorb the jar. Even in well constructed buildings the addition of a special beam or brace will often prevent the trouble from jarring machinery. In our factory the annoyance from a fussy jig-saw, running at a high rate of speed, was overcome by this method. Heavy machinery upon the first floor would best rest upon a separate foundation.

For general purposes the best seats will be found to be the ordinary four-legged, wooden-seated stool, with a home-made back added. This back is a thin piece of springy board, the top rounded off and bolted to the seat and lower round. This seat is easily mounted and dismounted. For persons standing or sitting, a foot-rest will be found of great service, for, by frequently changing from one foot to the other, the limbs are kept in a good condition. This is important to rheumatic and heavy-limbed persons. Experience has taught us, that, other things being equal, in making a journey we should select a route having cars with side foot-rests.

Saws are the leading element of danger in many factories. Probably ninety per cent. of all the accidents are the direct result of the violation of that golden rule, "Never put your hand *back* of a running saw." A piece of wood sticks a little, or a chip lodges at the back of the saw: the temptation presents itself for the workman to remove it without stopping the saw. He takes the risk, and perhaps carries a mutilated hand through life as the result. At the back of medium and large splitting saws, use a "horn." This keeps the cut open, and permits the saw to do its duty without pinching. Saws, in many kinds of work, may be covered, presenting only a slight cutting surface. Many of the circular saws are made for special work, and differ from the old-fashioned type in that a certain proportion of the teeth are hooked, instead of pointing outward. A workman would be badly mutilated on the former saw by his hand's being drawn in, while the latter would have a negative if not a repelling motion. It will be seen why these new saws demand great care upon the part of those running them. The foreman of our wood-shop says "he does not want a man to touch a saw who is afraid of it." He instructs a new hand as to the dangers, how to avoid them, and expects a cautious confidence to do the rest. During his administration of several years there has not been a serious injury in his department.

Universal moulding-machines, and others of that class, using a post or

cutter-head for holding the cutters, are most dangerous articles. The tendency is to draw in anything brought in contact. The general remarks applied to saws apply to these. There is one danger from these machines, even to the experienced hand,—that is, he may forget, when shifting the knives, to tighten them up if his attention is temporarily called away. We had one accident of this nature in our factory. It has been said there is not a person who has run one of these machines any length of time who has escaped without mutilation or cuts. We cannot contradict the assertion from our own knowledge.

In showing visitors over a manufacturing establishment, request them to lay aside their cigars, and impress upon them the importance of considering each piece of machinery as in motion. A nicely running saw or cutter-head, to many, conveys the idea of an object at rest.

Grindstones, if running at a high speed, should be covered. They, as well as emery wheels, should be placed in a room by themselves, or in a corner, out of the way of the other workmen. Many bad accidents have been the result of broken wheels. Fewer belt accidents would occur were loose pulleys more generally used, instead of leaving a belt to hang on the shaft when not in use, and putting on while running.

Some workmen have a practice of laying down their tools with the cutting end projecting over the edge of the bench. This is done to save the cutting surface. A better plan is to lay the tool point away from the workman, and resting on pieces of wood on the bench. We recall a case of a marketman, who, leaving his knife pointing outward, jumped forward in the act of hanging up some mutton, and received a fatal wound.

The liquor question, in a general way, it may not be proper for us to consider, but in its bearings upon factory life it is important. No workman should be permitted to work while under the influence of liquor, nor to run a piece of machinery till he has fully recovered from the effects of a spree. The chronic disordered condition of some workmen, after vacations and holidays, has caused many liberal-minded employers to contract the days off to the smallest possible number.

Accidents arise from amateur railroading, as in many cases the workmen act as switchmen or brakemen where side tracks enter the factory grounds. If possible, the side track should be in a straight line, as then a fair view may be had. Cars should not be moved at all without timely instruction and notice. It is quite common, where there are several cars, to leave one or more spaces for a passage-way through. Fatal accidents have resulted from pushing the cars together without notice. Reckless engineers delight in giving the cars a good "kick" in switching, when they know a green hand is at the brake. This trick was played upon a friend of ours upon his own premises. Had one of his men been at the brake, a fatal accident would have been the result. Even with his experience and strength, the car reached the dead end with a force that threw him from the car, leaving him hanging from the brake by his powerful arms.

Machinery kept constantly running, and under inspection, is less liable to break down and cause accidents than where it remains idle a good portion of the time.

Where the workmen are of good habits, it is better in depressed times to give vacations in turn rather than close entirely, or to give full work to only a few.

We believe in placing a seriously injured person as soon as possible under the care of a competent surgeon. In most places a few minutes must elapse before such skill is obtainable: hence the importance of such intelligent action as will present the patient to the doctor in the best condition. Concise elementary directions in case of accidents, published under medical supervision, are now obtainable in the large cities. These are printed upon card-board, and at least one of these notices should be posted in every factory. To supplement and carry out the medical directions recommended, an emergency box should be kept safely in some known place, and under the charge of some cool-headed, intelligent person. The emergency box should contain a few bottles of medicine, such as brandy, arnica, etc., prepared by an apothecary, each bottle properly labelled. The selection of the medicine should be left to a doctor or to an apothecary, who has knowledge of the dangers of the factory. Besides the above, each case should contain a Martin's rubber bandage, and a piece of rubber tube for tying; some small, strong rubber bands. These articles are for use in case of bleeding. A box of surgeon's plaster, cloth bandages, sponge, graduated glass (tea and table-spoonfuls), a medicine holder with spout, and a folding fan.

From a lay point of view we think the medical gentlemen have, in their instructions, given all that is required where assistance is within easy call, excepting the manner of handling. This subject has not received the attention it should, as "kind hands" are often very ignorant and clumsy. We believe a series of illustrations, showing the proper manner of lifting and supporting sick or wounded persons, would be of great benefit, not only to the factory, but also for the home.

A factory located in a good-sized city has the advantages of hospital ambulance and police patrol service. Where such wagons are in use, we recommend that each factory should own a stretcher fitting the vehicles. By this means a disabled person may at once be laid upon a stretcher ready for the hospital attendants upon their arrival. For other purposes, use a stretcher constructed in accordance with the views of the local doctor, not, however, losing sight of the removable handles, by which means in severe cases the handles may be removed, leaving the canvas upon the bed and under the patient.

To obtain the *best* medical attendance is often a serious matter for the disabled mechanic, owing to his lack of funds. The public hospitals in the large cities are all that could be expected, but they cannot cover the whole, and take care of every one needing medical assistance. Every establishment employing one hundred hands or over should organize a mutual relief association, for the purpose of paying medical fees and

nursing. The money could be used for paying for a free bed in some hospital. Where this convenience does not exist, an upper room in some comfortable building should be secured for the dangerously sick or wounded. We think in an establishment of ordinary risk a regular contribution of ten cents a week will be sufficient to pay all ordinary demands; any excess to be assessed, but not to exceed twenty five cents in any one week. Many workmen regard going to a hospital as but one remove from entering a jail. This ignorant idea should be dispelled, and would be by an acquaintance with any good hospital where trained nurses are employed. This idea, we feel, is quite common; and more popular information is required, so that a man will believe he enters a hospital to be *cured*, and not to die.

A shop danger (but thanks to local health officers a lessening one) is that from contagious diseases. Most American-born workmen recognize and respect the benefit of restriction in such cases. Many of foreign birth disregard these limitations, and recklessly endanger their fellow-workmen. As the latter are almost invariably the ignorant and most superstitious, relying upon charms rather than upon medical skill to effect a cure, the remedy suggested would seem to be,—restraining power first, then popular instruction. We consider the subject of personal cleanliness of more importance than the general shop condition. We know of a painter who attributes a large portion of the sickness of his trade to their handling their food and face with soiled hands,—his rule being to keep his hands away from his mouth unless they are perfectly clean. The hair and whiskers require to be kept clean. Few persons are aware how readily they absorb and hold impurities and particles from the atmosphere. In cleaning up, a few drops of ammonia in warm water will be found an excellent wash for the hair and whiskers, as it is, indeed, for the rest of the body. Hot water cannot always be conveniently carried over a building. In our factory we overcame the difficulty in this way: Our washing-up sinks are the ordinary long iron ones. At one end is placed a copper vessel holding several gallons. A cold-water pipe leads to this vessel, and a steam pipe enters it. By turning the steam valve the water may be blown up and heated as hot as desired. The hot water from this tank is dipped into the basin, and tempered from the independent cold water faucet to suit.

Workmen who bring their dinners should be furnished with facilities for heating or making tea or coffee. The refuse of all fruits, peach-stones and banana skins in particular, should be thrown into some proper receptacle. The floor is a most dangerous place when sprinkled with these articles.

Persons at work over poisonous substances should talk but little while at work: by so doing they breathe more through the nose. We have in mind a great talker,—a painter,—whose system seemed to be charged with the white lead paint which he applied to small articles upon the bench before him. His room-mates, of a less gossiping nature, escaped seemingly uninjured. The above occurred in a better lighted and venti-

lated paint room than is ordinarily seen. The physician summoned to this painter quickly diagnosed the trouble as lead poisoning, and stated the cause as readily as though he had been a shop-mate.

Most factories abreast of the times, whether engaged in metal, wood, or textile manufacturing, have special processes in which the use of poisonous chemicals is required. These should be kept in glass or earthen receptacles, properly labelled with the word "Poison," the antidote also being added. The best chemists now furnish their preparations thus labelled.

Economy of space in some buildings requires that the overhead (ceiling) spaces be used. Where this is done, keep the articles hung up away from over the work-benches as much as possible. Use hooks or pins, the outer ends of which are the highest. This prevents jars sending down the articles hung up. Pack goods on overhanging shelves so they cannot be shaken down. Keep tools, flower-pots, etc., off the window-sills, unless there is a guard to the window. One of our most respected state governors, now in office, once had a narrow escape from a flower-pot that fell from an upper window.

Observation has convinced us that the ordinary set rules, no matter how well framed, are distasteful to the average person, and fall short of the mark. Our attention was recently called to a set of rules for the guidance of a large bindery and printing establishment. It would hardly be possible for any one to comply with all of the requirements. One rule, however, so covered the whole that we repeat it from memory: "An honest day's work will be required for a full day's pay." Any person who is not willing to comply with this should be discharged. Each foreman should be held accountable for those in his immediate department, and he should have authority to discharge for cause. He should be consulted in taking on new hands.

The introduction of special machinery in almost every manufacturing department, has, in our opinion, a tendency to dwarf the man mentally, less skilled hand-work being required than under the old system. What we now consider as a trade was once only a part of a trade. This dwarfing of the mental faculties requires a counteracting influence, which must, we believe, come mainly through reading. We advocate anything that will enlarge and improve the mental condition. In view of the above, we recommend that each establishment have only the common rules posted, such as relate to smoking, elevators, etc., and that all details be printed in book form and given to each person employed. This book is to convey, in the way of *suggestions*, what is expected. The ideal must not be above the reach of any person in the factory. The truth should be advanced, that the interests of employer and employés are identical. Each person should feel that he is responsible for not only his own welfare, but also for that of his shop-mates. We believe such a presentation of the case will arouse in each workman an idea of his responsibilities, and a purpose to incorporate the suggestions in his daily shop-life.

APPENDIX.

PUBLICATIONS

OF THE

American Public Health Association.

The following constitute the published works of the Association:

Volume I—563 pages—contains 48 papers by 44 authors.
Volume II—552 pages—43 papers by 39 authors.
Volume III—241 pages—29 papers by 29 authors.
Volume IV—396 pages—37 papers by 33 authors.
Volume V—256 pages—20 papers by 19 authors.
Volume VI—497 pages—36 papers by 36 authors.
Volume VII—446 pages—33 papers by 30 authors.
Volume VIII—359 pages—21 papers by 20 authors.
Volume IX—460 pages—26 papers by 26 authors.
Volume X—546 pages—46 papers by 43 authors.
Volume XI—456 pages—17 papers by 17 authors.

A total of 356 different papers by 239 authors, not including 12 presidential addresses and many verbatim reports of interesting discussions of important questions.

Volume XII (now in press).

Lomb Prize Essays, 1885.

The above constitutes in itself a library upon sanitation, as will be seen in the more detailed analysis of the same in the following pages. So great has been the demand for these works in this and foreign countries, that but a few complete sets remain for sale in the hands of the treasurer.

LIST OF AUTHORS,

WITH THE TITLES OF THEIR RESPECTIVE PAPERS, IN THE FIRST TEN VOLUMES OF THE PUBLICATIONS OF THE AMERICAN PUBLIC HEALTH ASSOCIATION.

VOL. I.—AUTHORS, ALPHABETICALLY ARRANGED.

1. ALLEN, NATHAN, M. D., LL. D.
   1. Perfection of Structure in the Human Body as a Leading Element of Hygiene.
2. BAILEY, F. K., M. D.
   2. Cholera in Knoxville, Tenn., and Vicinity.
3. BARNARD, F. A. P., LL. D., President Columbia College.
   3. The Germ Theory of Disease in its Relations to Hygiene.
4. BEARD, GEORGE M., M. D.
   4. The Longevity of Brain-Workers.
5. BEEKMAN, Hon. JAMES W.
   5. Remarks upon one of the First Principles of Hospital Hygiene.
6. BLODGETT, LORIN, Esq.
   6. Report upon "Non-Periodic Changes of Heat as an Element in Sanitary Climatology."
7. BOARD OF HEALTH, of Little Rock, Ark.
   7. Cholera in Little Rock, Ark.
8. CHANDLER, C. F., Ph. D., M. D., LL. D.
   8. Report upon the Sanitary Chemistry of Waters, and Suggestions with regard to the Selection of the Water-Supply of Towns and Cities.
9. CLENDENIN, WILLIAM, M. D.
   9. The General Causes of Disease.
10. COX, CHRISTOPHER C., M. D., LL. D.
    10. A Report upon the Necessity for a National Sanitary Bureau.
11. ERSKINE, JOHN H., M. D.
    11. A Report on Yellow Fever as it appeared in Memphis, Tenn., in 1873.
12. FLINT, AUSTIN, M. D.
    12. Relations of Water to the Propagation of Fever.
13. GILMORE, J. T., M. D.
    13. An Account of Yellow Fever as it prevailed in Mobile and Vicinity in 1873.
14. HARRIS, ELISHA, M. D.
    14. Practical Conclusions concerning Cholera. Evidence respecting Causes and Preventive Measures.
    15. General Health Laws and Local Ordinances considered with reference to State and Local Sanitary Organization.
15. HARTSHORN, HENRY, M. D.
    16. What to do against Yellow Fever.
16. HUNT, EZRA M., M. D.
    17. The Need of Sanitary Organization in Villages and Rural Districts.
17. JANES, EDWARD H., M. D.
    18. Report on the Practical Lessons of the Recent Prevalence of Small-Pox, with reference to its Prevention in the Future.
18. JEPSON, S. L., M. D.
    19. Cholera in Wheeling, West Va., in 1873.

VOL. II.—AUTHORS, ALPHABETICALLY ARRANGED.

18. HARTSHORNE, HENRY, M. D.
    19. Report on Sanitary Conditions of Watering-Places.
    20. Infant Mortality in Cities.
19. HITCHCOCK, HOMER O., M. D.
    21. Relations of Excessive Use of Alcoholic Drinks to Public Health.
20. HUNT, EZRA M., M. D.
    22. Building-Ground and Dwelling-Houses in their Relations to Health.
21. HUNT, SANFORD B., M. D.
    23. Soil Drainage and Atmospheric Humidity.
22. JANES, EDWARD H., M. D.
    24. Health of Tenement Populations—Sanitary Requirements of their Dwellings.
23. KEDZIE, R. C., M. D.
    25. Report on Poisons as Insecticides in Agriculture, and Tests of their Effects on Food Vegetables.
24. KERR, Prof. W. C.
    26. Geological and Sanitary Relations of Drainage and Water Supply in No Carolina.
25. LAW, Prof. JAMES, D. V. S.
    27. Hereditary Entailments in Domestic Animals and in the Human Family.
    28. Report on Malignant Anthrax in Herds and Malignant Pustule in Man (on the Wadsworth estate).
26. LEE, BENJAMIN, M. D.
    29. Cost of a Great Epidemic to a Great City.
27. MAISCH, Prof. JOHN M.
    30. Pharmacy in its Sanitary Relations.
28. NOEL, H. R. M. D.
    31. Sewer-Gas as a Cause of Diphtheria and Typho-Malarial Diseases.
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    32. Certain Relations of Geology to the Water-Supplies of the Country.
30. OSGOOD, SAMUEL, D. D., LL. D.
    33. Health and the Higher Culture.
31. PEPPER, WILLIAM, M. D.
    34. The Sanitary Relations of Hospitals.
32. SMITH, STEPHEN, M. D.
    35. The Reciprocal Relations of an Efficient Public Health Service and the Highest Educational Qualifications of the Medical Profession.
    36. Hospitalism and Hospital Construction.
33. SNOW, EDWIN M., M. D.
    37. Does Small-Pox become Epidemic, or Spread only by its own Contagion?
34. STEINER, Hon. L. H., M. D.
    38. A Sanitary View of the Question, "Am I my Brother's Keeper?"
35. STERNBERG, GEORGE M., M. D.
    39. Yellow Fever in Pensacola, Fla., in 1873–'4–'5.
36. STURGIS, F. R., M. D.
    40. Relations of Syphilis to the Public Health.
37. TONER, JOSEPH M., M. D.
    41. The Leading Public Health Questions in the United States.
38. VIELÉ, E. L., C. E.
    42. Principles and Practice of Drainage and Sewerage, in connection with Water-Supplies.
39. WOODWORTH, JOHN M., M. D.
    43. Location, Plan, and Management of Hospitals, including one Report of Committee.

VOL. III.—AUTHORS, ALPHABETICALLY ARRANGED.

1. Bell, A. N., M. D.
    1. Marine Hygiene on board Passenger Vessels.
2. Billings, John S., M. D.
    2. Rights, Duties, and Privileges of the Community in relation to those of th Individual in regard to Health.
3. Brewer, Prof. William H.
    3. The Gases of Decay, and the Harm they cause in Dwellings, &c.
4. Claypole, Prof. E. W.
    4. The Popularization of Sanitary Science in Schools.
5. Committee, Report of.
    5. Report on the Preparation of a Plan for a Sanitary Survey of the United States.
6. Crowell, Henry G.
    6. Sanitary Regulations relating to Abattoirs.
7. Flint, Austin, M. D.
    7. Food in its relations to Personal and Public Health.
8. Gardner, James T., C. E.
    8. Relations of Topographical Surveys and Maps to Public Health.
9. Garvin, Lucius F. C., M. D.
    9. Sanitary Requirements in Factories—Injurious Effects of Cotton Factories upon the Health of Operatives.
10. Gihon, A. L., M. D.
    10. The Need of Sanitary Reform in Ship Life.
11. Harris, Elisha, M. D.
    11. Laws, Provisions, and Methods for securing the Benefits of General Vaccination throughout the Country.
12. Horsford, Prof. E. N.
    12. A New Profession in the service of Hygiene.
13. Hough, Franklin B., M. D.
    13. Health Interests in the Preservation of certain Primeval Forests, and the Cultivation of Trees.
14. Hunt, Ezra M., M. D.
    14. The Sanitary Appointments and Outfitting of Dwelling-Houses.
15. Janes, Edward H., M. D.
    15. Abattoirs and the Slaughtering Business in New York.
16. Lente, Frederick D., Jr., M. D.
    16. Florida as a Health Resort.
17. Lewis, Charlton T., Esq.
    17. Ancient and Modern Hygiene Contrasted—Influence of Civilization on the Duration of Life.
18. Morris, John, M. D.
    18. Scarlatina in Baltimore and Belair, Md.
19. Pfeiffer, Carl, F. A. I. A.
    19. A Report on Methods of Ventilation.
20. Segur, B. A., M. D.
    20. Privy Vaults and Cesspools.
21. Shedd, J. Herbert, C. E.
    21. Water-Supplies for Large Institutions and Small Communities.
22. Smith, Stephen, M. D.
    22. The Influence of Private Dwellings and other Habitations on Public Hygiene: the Relations of Sanitary Authority to them.
23. Steiner, Lewis H., M. D.
    23. Expert Supervision in Construction of Public Institutions.
24. Walker, Jerome, M. D.
    24. Summer Resorts for the Debilitated Children of our Cities.

VOL. IV.—AUTHORS, ALPHABETICALLY ARRANGED.

17. HITCHCOCK, Prof. EDWARD.
    19. Hygiene at Amherst College.
18. HOLLIDAY, D. C., M. D.
    20. Is Efficient Quarantine Possible or Practicable?
19. HUNT, EZRA M., M. D.
    21. How to Study an Epidemic.
    22. The Prophylactic Treatment of Individuals as a Means of Preventing Epidemics of Yellow Fever, or other Infective Diseases.
20. JENNINGS, R. G., M. D.
    23. The Quarantine at Little Rock, Ark., during August, September, and October, 1878, against the Yellow Fever Epidemic in Memphis and the Mississippi Valley.
21. LE CONTE, JOHN L., M. D.
    24. Sanitary Problems: the Proper and Rational Method in which Municipal Boards of Health should be Organized.
22. LINDSLEY, J. B., M. D.
    25. Report on the Yellow Fever in Nashville, Tenn., September and October, 1878.
23. LYMAN, HENRY M., M. D.
    26. A Review of the Present State of Exact Knowledge regarding the Causation of Epidemic Infectious Diseases.
24. MORRIS, JOHN, M. D.
    27. History of the Epidemic in Baltimore in 1876.
25. MCCLELLAN, ELY, M. D.
    28. A Study of the Yellow Fever Epidemic of 1876, as it affected the State of Georgia.
26. PLUNKET, J. D., M. D.
    29. Disinfection of Sewers by Ozone.
27. RAUCH, JOHN H., M. D.
    30. The Sanitary Problems of Chicago.
28. SELDEN, WILLIAM, M. D.
    31. Views on the Subject of Prevention of Yellow Fever.
29. SMART, CHARLES, M. D.
    32. Abstract of a Report on the Spring, Well, and River Waters in the Department of the Platte, made to the Medical Director U. S. Army, under date of May 26, 1876.
    33. Abstract of a Report on Certain Points in Medical Climatology.
30. STEINER, LEWIS H., M. D.
    34. An Address on the Objects of the Association, and its Claims upon the People for Sympathy and Support.
31. TAYLOR, J. HOWARD, M. D.
    35. Memorandum concerning the Refugee Cases of Yellow Fever in Philadelphia, 1878.
32. TURNER, T. J., A. M., M. D., Ph. D.
    36. Air and Moisture on Shipboard: a Fragment of Applied Physiology.
33. VANDEMAN, J. H., M. D.
    37. Yellow Fever as it Existed in Chattanooga, Tenn.—Its Origin, Progress, and the Probable Remedy for its Abatement in the Future, including one Report of Delegation.

VOL. V.—AUTHORS, ALPHABETICALLY ARRANGED.

1. BREWER, Prof. W. H.
    1. On Rotting Wood.
2. CAMERON, Col. JOHN F.
    2. Camps—Depopulation of Memphis—Epidemics, 1878 and 1879.

3. CAMPBELL, HENRY F., M. D.
    3. The Yellow Fever Quarantine of the Future, as Organized upon the Portability of Atmospheric Germs, and upon the Non-Contagiousness of the Disease.
4. CHANDLER, J., M. D.
    4. How to Deal with a First Case and Early Cases of Yellow Fever, when, in spite of Precautions, it has made its Appearance.
5. CLARKE, ELIOT C., C. E.
    5. City Scavengering in Boston.
6. COMPTON, J. W., M. D.
    6. Underground Sewers.
7. CUMMINGS, JOHN B., M. D.
    7. The Inefficiency of Quarantine in the State of Arkansas during the Year 1879.
8. GIHON, ALBERT L., M. D.
    8. On the Protection of the Innocent and Helpless Members of the Community from Venereal Diseases and their Consequences.
9. JAMES, BUSHROD W., M. D.
    9. International Quarantine.
10. JANEWAY, EDWARD G., M. D.
    10. Remarks upon Necessity for the Filing in a Public Office of Plans and Statements about Certain Matters of House Construction—Upon the Study of the Origin of Contagious Diseases, and the Liability to Error in this Direction—Upon the Necessity for Uniformity in the Publication of Vital Statistics.
    11. On Post-Mortem Examinations and their Relations to the Public Health.
11. JENNINGS, R. G., M. D.
    12. Quarantine and its Results in the State of Arkansas, 1879.
12. MUNROE, Prof. CHARLES E., U. S. N. A.
    13. Action of Vegetable Acids on Tin.
13. PLUNKET, J. D., M. D.
    14. Cotton as a Fomite.
14. SMITH, STEPHEN, M. D.
    15. History of the Association.
15. THOMPSON, Rev. HUGH MILLER.
    16. Method Introduced by the Auxiliary Sanitary Association for Disposing of the Garbage of New Orleans.
16. THORNTON, G. B., M. D.
    17. Yellow Fever Epidemic in Memphis, 1879.
17. TYNER, T. J., M. D.
    18. Etiology of Yellow Fever, with Remarks on Quarantine.
18. WARING, GEORGE E., Jr., C. E.
    19. The Sewerage and Drainage of Cities.
19. WOODHULL, ALFRED A., M. D.
    20. May not Yellow Fever Originate in the United States?

VOL. VI.—AUTHORS, ALPHABETICALLY ARRANGED.

1. ATCHISON, T. A., M. D.
    1. The Disposal of our Dead.
2. BAKER, HENRY B., M. D.
    2. The Relations of Schools to Diphtheria, etc
3. BELL, A. N., M. D., A. M.
    3. The Relations of Certain Filth Diseases to Cold Weather.
4. BREWER, Prof. WILLIAM H.
    4. On the Action of Muddy Water on Sewage.

29. SMITH, JOSEPH R., M. D.
    29. Disease among Texas Cattle.
30. STERNBERG, GEORGE M., M. D.
    30. Yellow Fever and Quarantine.
31. STORER, HORATIO R., M. D.
    31. Sanitary Protection in Newport.
32. THOMAS, J. G., M. D.
    32. Dengue.
33. THORNTON, G. B., M. D.
    33. Memphis Sanitation and Quarantine, 1879 and 1880.
34. TURNER, T. J., M. D.
    34. The Hygiene of Emigrant Ships.
35. WARING, GEORGE E., Jr., C. E.
    35. Storm-Water in Town Sewerage.
36. WIGHT, O. W., M. D.
    36. The Management of Contagious and Infectious Diseases in Milwaukee.

VOL. VII.—AUTHORS, ALPHABETICALLY ARRANGED.

1. ADAMS, J. F. A., M. D.
    1. Malaria in New England.
2. BROOKS, Hon. ERASTUS.
    2. What the People owe to the State.
3. BURGESS, DANIEL M., M. D.
    3. Practical Experiences in regard to the Infection of Vessels with Yellow Fever at Havana.
4. CABELL, J. L., M. D.
    4. The Rise and Progress of International Hygiene.
5. CAMPBELL, Prof. JOHN L.
    5. "The Kankakee:" a Sanitary Problem of Indiana.
6. CHAMBERLAIN, C. W., M. D.
    6. Malaria in Connecticut.
7. CURTIS, W. H., M. D.
    7. The Disposal of the Dead.
8. DUNCAN, T. C., M. D.
    8. The Atmospheric Element in Epidemics.
9. FENNER, EDWARD, Esq.
    9. History of the New Orleans Auxiliary Association.
10. FOLSOM, CHARLES F., M. D.
    10. The Prevention of Insanity.
11. FOSTER, EUGENE, M. D.
    11. The Municipal Organization of the American Public Health Service.
12. GARNETT, ALEX. Y. P., M. D.
    12. Observations on the Potomac Marshes at Washington, D. C.
13. GIHON, ALBERT L., M. D.
    13. Health the True Nobility.
14. GORGAS, A. C., M. D.
    14. Effects of Tobacco on Youths.
15. HERRICK, S. S., M. D.
    15. Railroad Sanitation, its Objects and Advantages.
    16. The Comparative Vital Movement of the White and Colored Races in the United States.
16. HORLBECK, H. B., M. D.
    17. Scarlet Fever in Charleston, S. C.
17. HUNT, EZRA M., M. D.
    18. The Contagious Diseases of Domestic Animals.

VOL. VIII.—AUTHORS, ALPHABETICALLY ARRANGED.

11. Keating, Col. J. M.
    12. The Cremation of Excreta and Household Refuse.
12. Mills, H. R., M. D.
    13. The Immigrant Inspection Service of the National Board of Health at Port Huron, Mich., and its Bearing on the Public Health of the West and North-West.
13. Newell, T., M. D.
    14. The Sanitary, Physical, and Educational Advantages of Interior Open-air Areas in Large Cities.
14. Smith, Joseph R., M. D.
    15. Observations on Texas Cattle, Age, Weight, Temperature, Liver, and Spleen.
15. Speed, John J., M. D.
    16. The Relations of Health Associations to the Practice of Medicine.
16. Stevens, Thad. M., M. D.
    17. A History of Health-Work in Indiana.
17. Storer, Horatio R., M. D.
    18. The Newport (Edinburgh) System of Sanitary Protection.
18. Thornton, G. B., M. D.
    19. The Negro Mortality of Memphis.
19. Wight, O. W., M. D.
    20. Laws Requiring Medical Men to Report Deaths and Cases of Infectious Diseases to the Public Authorities.
20. Wilson, T. P., M. D.
    21. Life on Wheels—Its Sanitary Needs.

VOL. IX.—AUTHORS, ALPHABETICALLY ARRANGED.

1. Belfield, William T., M. D.
    1. Swell-Head in Cattle.
2. DeWolf, O. C., M. D.
    2. Pullman from a State Medicine Point of View.
3. Ferguson, David, M. D.
    3. Preventable Contagious Diseases.
4. Foster, Eugene, M. D.
    4. Report of the Committee on Compulsory Vaccination; also a Supplementary Report on the Efficiency and Safety of Vaccination.
5. Gihon, Albert L., M. D.
    5. Vital Statistics as Sanitary Monitors.
6. Hargis, R. B. S., M. D.
    6. The Pensacola Yellow Fever Epidemic of 1882.
7. Hering, Rudolph, C. E.
    7. Essential Features of House Drainage, and Practical Points regarding its Design and Construction.
8. Janes, E. H., M. D.
    8. Typhus Fever in New York City.
9. Leeds, Prof. Albert R., Ph. D.
    9. The Adulteration of Foods.
10. Lundy, Charles J., A. M., M. D.
    10. School Hygiene.
11. Newton, William K., M. D.
    11. The Sanitary Control of the Food-Supply.
12. Oldright, William, A. M., M. D.
    12. The Overhead Ventilation of Sewers.
13. Partridge, J. M., A. M., M. D.
    13. Swine Plague, or Hog Cholera.

14. Penn, J. W., M. D.
    14. Interrogatories on Malarial Fever.
15. Pratt, Foster, M. D.
    15. The Increase of Insanity in the United States: its Causes and its Sources.
16. Raymond, Joseph H., M. D.
    16. House Sanitation.
17. Reeves, James E., M. D.
    17. The Eminent Domain of Sanitary Science, and the Usefulness of State Boards of Health in Guarding the Public Welfare.
18. Salmon, D. E., D. V. M.
    18. Texas Cattle Fever: Is it a Chimera, or a Reality?
19. Sargent, Prof. D. A.
    19. Physical Training.
20. Smart, Charles, M. D.
    20. On the Prevention of Malarial Diseases.
21. Smith, Joseph R., M. D.
    21. Observations on Texas Cattle: Age, Weight, Temperature, Liver, and Spleen.
22. Sternberg, George M., M. D.
    22. Malaria.
23. Watson, Prof. J. Madison.
    23. Physical Training.
24. Webb, R. D., M. D.
    24. The Changes of Type which Malarial Fevers have Undergone in Sumter County, Ala., from 1833 to 1883.
25. Wood, Thomas F.
    25. The Clinical Thermometer in the Prevention of Malarial (Paludal) Fever, especially that Form of it to which Seamen sailing out of South Atlantic and Gulf Ports are Liable.
26. Woodhull, A. A., M. D.
    26. The Etiological Association of Organic Matter with Malaria.

VOL. X.—AUTHORS, ALPHABETICALLY ARRANGED.

1. Alt, Adolf, M. D.
    1. On Protective Spectacles for Workingmen.
2. Baker, Henry B., M. D.
    2. The Relation of the Depth of Water in Wells to the Causation of Typhoid Fever.
3. Beugless, John D., Chaplain U. S. A.
    3. Cremation as a Safeguard against Epidemics.
4. Brewer, Prof. W. H.
    4. Glucose in its Sanitary Aspects.
5. Brooks, Hon. Erastus.
    5. The Food we eat, the Liquids we drink, and the Adulterations we submit to.
6. Chancellor, C. W., M. D.
    6. The Squalid Dwellings of the Poor—a Social and Sanitary Reproach.
7. Conery, W. B., M. D.
    7. Sanitary Care in Stock Transportation in the Prevention and Control of Texas Cattle Fever.
8. Cook, W. C., M. D.
    8. Public Health and Legislation.
9. Cornwall, Prof. H. B.
    9. Adulteration of Beer.
10. Curtman, Charles O., M. D.
    10. On Heating and Ventilation of Dwellings and School-Rooms.

11. DAVENPORT, BENNETT F., M. D.
    11. Adulterations of Food and Drugs.
12. ELDER, E. S., M. D.
    12. Sanitary Survey of the School-Houses in Indiana.
13. FORMENTO, FELIX, M. D.
    13. School Hygiene.
14. FRY, FRANK R., A. M., M. D.
    14. The Manufacturer of Soda-Water from Polluted Well-Water.
15. HARRIS, W. JOHN, M. D.
    15. The Chemical Disposition of Sewage.
16. HARTWELL, EDWARD MUSSEY, M. D., Ph. D.
    16. On Physical Training in the United States.
17. HERRICK, S. S., M. D.
    17. The Relation between Underground Sewerage and Filth Diseases.
18. HOMAN, GEORGE, M. D.
    18. A Sanitary Survey of St. Louis; being a Series of Short Papers on Leading Public Health Topics, contributed by City Officials and Local Sanitarians.
    19. The Situation, Surroundings, and Soil of St. Louis. Considered from a Hygienic Standpoint.
    20. The Leading Local Productive Industries, and their Effect on the Health and Lives of their Operatives.
19. KEATING, J. M.
    21. The Ultimate of Sanitation by Fire.
20. LUEDEKING, ROBERT, M. D.
    22. The Chief Local Factors in the Causation of Disease and Death.
21. MOORE, ROBERT, C. E.
    23. Sewerage and House Drainage in St. Louis.
    24. Notes upon the History of Cholera in St. Louis.
22. MORRIS, J. CHESTON, M. D.
    25. The Milk-Supply of our Large Cities—The Extent of Adulteration and its Consequences—Methods of Prevention.
23. MUNROE, Prof. CHARLES E., U. S. N. A.
    26. The Use of Cotton-Seed Oil as Food and for Medicinal Purposes.
24. NEWTON, WILLIAM K., M. D.
    27. The Sanitary Survey of a House.
25. NIPHER, Prof. F. E.
    28. The Mean Temperature and Climatic Conditions of St. Louis.
26. PARKER, W. THORNTON, M. D.
    29. The Sanitary Management of Railway Cars and Stations.
27. PARTRIDGE, J. M., A. M., M. D.
    30. Protection against Hydrophobia.
28. REEVES, JAMES E., M. D.
    31. Pollution of the Upper Ohio, and the Water-Supply of the Cities and Chief Towns within the first Five Hundred Miles of its Course.
29. RICHEY, S. O., M. D.
    32. Deterioration of Vision in School Children.
30. ROBINSON, Major SAMUEL A.
    33. Hygiene of the Habitations of the Poor.
31. ROHÉ, GEORGE H., M. D.
    34. The Hygiene of Occupations.
32. SMART, CHARLES, M. D.
    35. On the Present and Future of Sanitary Water Analysis.
33. SPIEGELHALTER, JOSEPH, M. D.
    36. The Local Milk-Supply—Its Sources and Quality.
34. STERNBERG, GEORGE M., M. D.
    37. Disease Germs.

VOL. XI.—AUTHORS, ALPHABETICALLY ARRANGED.

15. SALMON, D. E., M. D.
    15. The Virus of Hog Cholera.
16. WIGHT, O. W., M. D.
    16. Experiments in Disinfecting Sewers.
17. WOOD, THOMAS F., M. D.
    17. Observations upon the Cape Fear River as a Source of Water-Supply.

(The Report of the Committee on Disinfectants constitutes one of the most valuable papers in this volume.)

Total number of different authors, ... 239
*Total number of papers contributed, ... 356

*The Reports of Committees and Delegations, four in number, in the above list, are not included in this total.

CONSTITUTION

OF THE

AMERICAN PUBLIC HEALTH ASSOCIATION.

TITLE.

I. This Association shall be called "The American Public Health Association."

OBJECTS.

II. The objects of this Association shall be the advancement of sanitary science and the promotion of organizations and measures for the practical application of public hygiene.

MEMBERS.

III. The members of this Association shall be known as Active and Associate. The Executive Committee shall determine for which class a candidate shall be proposed. The *Active* members shall constitute the permanent body of the Association, subject to the provisions of the constitution as to continuance in membership. They shall be selected with special reference to their acknowledged interest in or devotion to sanitary studies and allied sciences, and to the practical application of the same. The *Associate* members shall be elected with special reference to their general interest only in sanitary science, and shall have all the privileges and publications of the Association, but shall not be entitled to vote.

Delegates from national, state, provincial, and municipal boards of health, organized sanitary associations, and the army, navy, and marine hospital service, shall be entitled to be enrolled as active members upon presentation of their credentials to the Executive Committee. Members, not delegates from such bodies shall be elected as follows :—

Each candidate for admission shall first be proposed to the Executive Committee, in writing (which may be done at any time), with a statement of the business or profession and special qualifications of the person so proposed. On recommendation of a majority of the committee, and on receiving a vote of two thirds of the members present at a regular meeting, the candidate shall be declared duly elected a member of the Association. The annual fee of membership in either class shall be five dollars.

OFFICERS.

IV. The officers shall be a President, a First and Second Vice-President, a Secretary, and a Treasurer.

All the officers shall be elected by ballot, annually, except the Secretary, who shall be elected for a term of three years.

PRESIDING OFFICER.

V. The President, or in his absence, one of the Vice-Presidents, or in their absence, a Chairman *pro tempore*, shall preside at all meetings of the Association. He shall preserve order, and shall decide all questions of order, subject to appeal to the Association. He shall also appoint all committees authorized by the Association, unless otherwise specially ordered.

SECRETARY.

VI. The Secretary shall have charge of the correspondence and records of the Association; and he shall also perform the duties of Librarian. He, together with the presiding officer, shall certify all acts of the Association. He shall, under the direction of the Executive Committee, give due notice of the time and place of all meetings of the Association, and attend the same. He shall keep fair and accurate records of all the proceedings and orders of the Association; and shall give notice to the several officers, and to the Executive and other Committees, of all votes, orders, resolves, and proceedings of the Association, affecting them or appertaining to their respective duties.

TREASURER.

VII. The Treasurer shall collect and take charge of the funds and securities of the Association. Out of these funds he shall pay such sums only as may be ordered by the Association, or by the Executive Committee. He shall keep a true account of his receipts and payments; and, at each annual meeting, render the same to the Association, when a committee shall be appointed to audit his accounts. If from the annual report of the Treasurer there shall appear to be a balance against the treasury, no appropriation of money shall be made for any object but the necessary current expenses of the Association, until such balance shall be paid.

STANDING COMMITTEES.

VIII. There shall be the following standing committees: (1) The Executive Committee, (2) the Advisory Council, (3) the Committee on Publication.

EXECUTIVE COMMITTEE.

IX. The Executive Committee shall consist (1) of the President, First Vice-President, Second Vice-President, Secretary, and Treasurer; (2) of six active members, of whom three shall be elected annually by ballot, to

serve two years, and who shall be ineligible to reëlection for a second successive term; and (3) of the ex-Presidents of the Association.

It shall be the duty of the Executive Committee to consider and recommend plans for promoting the objects of the Association; to authorize the disbursement and expenditure of unappropriated moneys in the treasury for the payment of current expenses; to consider all applications for membership, and, at the regular meetings, report the names of such candidates as a majority shall approve; and, generally, to superintend the interests of the Association, and execute all such duties as may, from time to time, be committed to them by the Association. At least one month preceding the annual meeting of the Association, the Executive Committee shall cause to be issued to members a notice of such meeting, and they are authorized to publish the same in medical, scientific, and other periodicals, but without expense to the Association; and such notice shall contain the order of business to be followed at said meeting, and, briefly, the subjects to be presented, and the special points of discussion.

ADVISORY COUNCIL.

X. The Advisory Council shall consist of one member from each State, Territory, and District, the Army, Navy, and Marine Hospital Service, the Dominion of Canada, and each of the Provinces, who shall be appointed by the President on the last day of each session, and who, besides acting as a nominating committee of officers for the ensuing year, to be announced at such time as the Executive Committee may appoint, shall consider such questions and make such recommendations to the Association as shall best secure the objects of the Association. They shall at their first meeting elect from their own number a Secretary, whose record of their proceedings shall be made part of the records of the Association.

COMMITTEE ON PUBLICATION.

XI. The Committee on Publication shall consist of the Secretary and two active members, selected by the Executive Committee, who shall contract for, arrange, and publish, under authority of the Executive Committee, the proceedings of the Association, including such papers as have been examined and approved by the Executive Committee, or which have been submitted to them by the latter for their discretionary action.

REPORTS AND PAPERS.

XII. All committees, and all members preparing scientific reports or papers to be laid before the Association at its annual meetings, must give, in writing, the title of such reports or papers, the time to be occupied in reading them, and an abstract of their contents, to the Executive Committee, at least one week preceding the date of such meeting, to secure their announcement in the order of business.

MEETINGS.

XIII. The time and place of each annual meeting shall be fixed at the preceding annual meeting, but may be changed by the Executive Committee for reasons that shall be specified in the announcement of the meeting. Special meetings may be called, at any time or place, by concurrence of two thirds of the Executive Committee. There shall be no election of officers, or change of By-laws, or appropriation of money to exceed the amount at that time in the treasury, at such special meeting, except by a vote of a majority of all the members of the Association. Whenever a special meeting is to be held, at least one month's notice shall, if possible, be given by circular, to all the members, together with the order of business.

QUORUM.

XIV. At the annual meeting nine members shall constitute a quorum for the election of officers, a change of the Constitution, the election of members, and the appropriation of moneys.

ORDER OF BUSINESS.

XV. The order of business at all meetings of the Association shall be fixed by the Executive Committee, and such order must be completed before any other business is introduced, except such order of business is suspended by a vote of four fifths present.

ALTERATION OF CONSTITUTION.

XVI. No alteration in the Constitution of the Association shall be made except at an annual meeting, nor unless such alteration shall have been proposed at a previous meeting, and entered on the minutes with the name of the member proposing the same, and shall be adopted by a vote of two thirds of the members present.

OFFICERS AND COMMITTEES

OF THE

AMERICAN PUBLIC HEALTH ASSOCIATION.

ORGANIZATION, 1886–1887.

President, . . .	Dr. GEORGE M. STERNBERG, U. S. A., *Baltimore, Md.*
First Vice-President,	Dr. CHARLES N. HEWITT, *Red Wing, Minn.*
Second Vice-President,	Dr. CHARLES A. LINDSLEY, *New Haven, Conn.*
Secretary, . . .	Dr. IRVING A. WATSON, *Concord, N. H.*
Treasurer, . .	Dr. J. BERRIEN LINDSLEY, *Nashville, Tenn.*

(*Ex-officio* Members Executive Committee.)

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(Elective.)

Dr. HENRY B. BAKER	*Lansing, Mich.*
Prof. HOSMER A. JOHNSON	*Chicago, Ill.*
Dr. JOSEPH HOLT	*New Orleans, La.*
Dr. GEORGE H. ROHÉ	*Baltimore, Md.*
Col. D. P. HADDEN	*Memphis, Tenn.*
Dr. FREDERICK MONTIZAMBERT	*Quebec, Canada.*

(The ex-Presidents, *ex-officio* members Executive Committee.)

Dr. STEPHEN SMITH	*New York city.*
Dr. JOSEPH M. TONER	*Washington, D. C.*
Dr. EDWIN M. SNOW	*Providence, R. I.*
Dr. JOHN H. RAUCH	*Springfield, Ill.*
Prof. JAMES L. CABELL	*University of Virginia, Va.*
Dr. JOHN S. BILLINGS	*U. S. Army.*
Prof. ROBERT C. KEDZIE	*Lansing, Mich.*
Dr. EZRA M. HUNT	*Trenton, N. J.*
Dr. ALBERT L. GIHON	*U. S. Navy.*
Dr. JAMES E. REEVES	*Wheeling, W. Va.*
Dr. HENRY P. WALCOTT	*Cambridge, Mass.*

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Alabama, . . .	Dr. JEROME COCHRAN, *Mobile.*
Arkansas, . . .	Dr. H. C. DUNAVANT, *Osceola.*
California, . .	Dr. S. H. ORME, *Los Angeles.*
Colorado, . . .	Dr. CHARLES AMBROOK, *Boulder.*
Connecticut, . .	Dr. R. S. GOODWIN, *Thomaston.*
Delaware, . . .	Dr. L. P. BUSH, *Wilmington.*
Florida, . . .	Dr. ROBERT B. S. HARGIS, *Pensacola.*

Georgia,	Dr. W. H. Elliot, *Savannah.*
Illinois,	Dr. Oscar C. DeWolf, *Chicago.*
Indiana,	Dr. J. D. Gatch, *Lawrenceburg.*
Iowa,	Dr. J. F. Kennedy, *Des Moines.*
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Louisiana,	Dr. L. F. Salomon, *New Orleans.*
Maine,	Dr. Frederic H. Gerrish, *Portland.*
Maryland,	Dr. W. G. Van Bibber, *Baltimore.*
Massachusetts,	Dr. S. H. Durgin, *Boston.*
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Mississippi,	Dr. Wirt Johnston, *Jackson.*
Missouri,	Dr. E. M. Nelson, *St. Louis.*
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Pennsylvania,	Dr. Benjamin Lee, *Philadelphia.*
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South Carolina,	H. D. Fraser, *Charleston.*
Tennessee,	Dr. J. D. Plunket, *Nashville.*
Texas,	Dr. R. M. Swearingen, *Austin.*
Vermont,	Hon. Henry D. Holton, *Brattleboro'.*
Virginia,	Dr. J. G. Cabell, *Richmond.*
West Virginia,	Dr. C. T. Richardson, *Charleston.*
Wisconsin,	J. T. Reeve, *Appleton.*
Dist. of Columbia,	D. E. Salmon, D. V M., *Washington.*
U. S. Army,	Dr. Joseph R. Smith, *New York city.*
U. S. Navy,	Medical Director Albert L. Gihon, *Mare Island, Cal.*
U. S. M. H. Service,	Surgeon John B. Hamilton, *Washington, D. C.*
Domin. of Canada,	Charles W. Covernton, *Toronto.*
Prov. of Ontario,	Dr. William Oldright, *Toronto.*
Prov. of Quebec,	F. N. Boxer, C. E., *Montreal.*
Manitoba,	Dr. Wm. R. D. Sutherland, *Winnipeg.*
New Brunswick,	Dr. Wm. S. Harding, *St. John.*

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The Secretary, *ex-officio.*

Dr. Alfred F. Holt	*Cambridge, Mass.*
Dr. Granville P. Conn	*Concord, N. H.*

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Dr. Ezra M. Hunt, Secretary State Board of Health of New Jersey.
Dr. Frederic H. Gerrish, President State Board of Health of Maine.
Dr. J. T. Reeve, Secretary State Board of Health of Wisconsin.
Dr. Joseph Holt, President State Board of Health of Louisiana.
Dr. Thomas F. Wood, Secretary State Board of Health of North Carolina.

Dr. C. N. Metcalf, Secretary State Board of Health of Indiana.
Dr. G. G. Tyrrell, Secretary State Board of Health of California.
Dr. Peter H. Bryce, Secretary Provincial Board of Health of Ontario.

ON DISINFECTANTS.

Maj. George M. Sternberg, U. S. A. . . . . Baltimore, Md.
Prof. George H. Rohé . . . . Baltimore, Md.
Maj. Charles Smart, U. S. A. . . . . Washington, D. C.
Prof. V. C. Vaughan . . . . Ann Arbor, Mich.
Dr. Joseph H. Raymond . . . . Brooklyn, N. Y.
Dr. Joseph Holt . . . . New Orleans, La.
Dr. Samuel H. Durgin . . . . Boston, Mass.

ON THE POLLUTION OF WATER-SUPPLY.

Dr. Charles Smart, U. S. A. . . . . Washington, D. C.
Dr. S. W. Abbott . . . . Wakefield, Mass.
Dr. G. C. Ashmun . . . . Cleveland, Ohio.
Prof. W. W. Daniells . . . . Madison, Wis.
Dr. Edward Playter . . . . Ottawa, Canada.

ON THE DISPOSAL OF GARBAGE.

Dr. James E. Reeves . . . . Wheeling, W. Va.
Dr. Louis Laberge . . . . Montreal, P. Q.
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